TECHNOLOGICAL DIMENSION OF SUSTAINABLE RURAL DEVELOPMENT : A STUDY OF A VILLAGE CLUSTER IN UTTAR PRADESH

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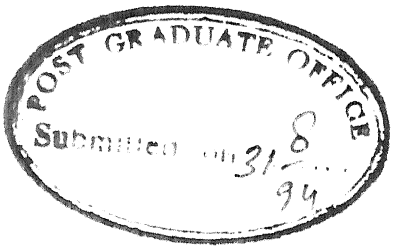

CERTIFICATE

It is certified that the work contained in the thesis entitled "Technological Dimension of Sustainable Rural Development: A Study of a Village Cluster in Uttar Pradesh", by Sharad Kunjan Tapasvi, has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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The problem of poverty and impoverishment in Indian rural society is varied and multi-faceted. Several social, economic, psychological and ecological factors affect the nature and course of impoverishment and deprivation in village communities. While a macro-structural analysis of these factors is necessary, it may not provide an adequate basis for the design of social action to achieve goals of planned change at the micro level.

In the present study,an effort has been made to build a conceptual and methodological framework for planned transformation of impoverishment inducing factors at the level of a village cluster. Since technology provides a potent source of wealth creation, productivity improvement, and resource generation, the study focuses on the context specific requirements of technology selection and management for sustainable development in a given empirical context. The village cluster selected for study and investigation is located in HARDOI, one of the most underdeveloped districts of Uttar Pradesh. A systemic learning-process approach

has been adopted as the conceptual and methodological orientation of the study.

The village cluster in the present context is viewed as a socio-ecological system (SES). It is posited that if socio-ecological impoverishment in the cluster is to be checked and reversed, then a process of sustained and sustainable development has to be initiated. The planning for this needs to be based on: (i) technology focused approach to development intervention, and (ii) an effective delivery system for technology transfer and planned implementation. The process of sustainable rural development in the SES is thought of as consisting of a set of five interconnected activity areas related to the development of natural resources, infrastructure, human resources, agriculture and rural industry. The performance objectives of the SES are defined as productivity improvement (PRI); employment and income generation (EIG); basic need satisfaction (BNS); synergistic production (SYP); and sustainability of resource use (SRU). They provide the base for the formulation of technological modules for implementation.

The participatory rural appraisal (PRA) methods are used to generate village-cluster-specific data about socio-ecological profile, nature and dynamics of impoverishment, specific problem dimensions, felt development needs, technological solutions and organisational requirements. The dynamics of the impoverishment process are analysed and delineated in the form of a multi-feedback loop social cybernetic model.

The specific objectives of the study are: (i) to depict the socio-economic and ecological profiles of the village cluster; (ii) to examine on-going rural development efforts in the cluster; (iii) to explore and delineate the nature and dynamics of impoverishment and problems of underdevelopment in the cluster; (iv) to identify policy measures for meeting developmental needs of the cluster's population; (v) to identify appropriate technological modules for sustainable development in the given cluster; (vi) to explore the sociological issues relevant for the introduction and management of the identified technological modules; and (vii) to highlight organisational requirements for the technology-based strategy of sustainable development in the given context.

The study is organised into eight chapters. Chapter 1 outlines the importance of technology, and the need for an efficient and effective technology delivery system for sustainable development of impoverished rural areas. The conceptual framework and the logical structure of investigation are discussed and elaborated in Chapter 2.

The socio-economic and ecological profiles of the village cluster are outlined in Chapter 3. The socio-economic profile portrays the village social organisation, existing base of knowledge and skills (i.e. know-how and technologies-in-use), consumption pattern, and production possibilities. The ecological profile reveals the prevalence of factors that impede the

achievement of performance objectives of sustainable development in the cluster. These cluster-specific ecological factors comprise rainfed agriculture; soil alkalinity; expanding wastelands; water-logging in the fields at the time of heavy rains; defective canal irrigation; scarcity of fuelwood; absence of grasslands for fodder; poor utilization of common property resources; clogged water courses etc.

The existing development scene and dynamics of impoverishment in the village cluster are examined in Chapter 4. An appraisal of current rural development programmes in the cluster reveals that they are ad hoc, unfocused, and unintegrated. Further, none of these programmes is seen to have achieved its intended objectives. It is further observed that the impacts of some programmes have unexpectedly led to negative consequences for other performance objectives. This has happened due to the neglect of location-specific social and ecological factors in the planning and implementation of development programmes. Chapter 4 also delineates the dynamics of the impoverishment process. The multi-feedback loop model of the process brings out six salient factors underlying the extant situation as a whole. These salient variables are: (i) Faulty planning and implementation of government's development schemes; (ii) Low agricultural productivity; (iii) Poor quality of life; (iv) Impoverishment and deprivation; (v) Inadequate investible capital; and (vi) Unproductive resource use.

Chapter 5 focuses on the empirical examination and analysis of the salient variables of the impoverishment process. This helps identify the cluster-specific problem dimensions on the one hand, and the required technological and organisational policy measures for addressing them, on the other. The identified policy measures define a set of forty solution elements that constitute the techno-structural thrust of developmental intervention in the cluster. They are also seen to constitute the set of necessary conditions for problem-solving or achieving the goal-state of the system in terms of its salient variables. Of these, thirty two policy measures pertain to relevant technologies. The remaining eight policy measures are concerned with organisational planning for technology transfer and management. The policy measures are analysed further in terms of a binary matrix to bring out their relative differential importance on the one hand, and the relative intractability of the problem dimensions, on the other.

Chapter 6 elaborates the nature and relevance of technological policy measures for the five activity areas of sustainable rural development. The identified technologies are not, however, disparate and discrete. They possess mutually supportive linkages. On the basis of mutually supportive or synergistic relationships among the relevant technologies, a set of five technological modules (TM) are deduced for sustained application in the given village cluster. The five TMs comprising relevant technologies are: (i) TM for Employment and Income Generation; (ii) TM for Productivity Improvement; (iii) TM for

Basic Need Satisfaction; (iv) TM for Synergistic Production; and (v) TM for Sustainability of Resource Use. In this context, a concept of 'technology atlas' is also presented. It is meant to highlight the nature of a context-specific technology roadmap for development. The sociological issues involved in the introduction and management of technological modules are also discussed in this chapter.

Chapter 7 briefly discusses the organisational design requirements for technology transfer and management. The discussion is anchored around certain basic principles of organisational design, and proposes a new delivery system design for technology transfer in the village cluster. The new system needs to be a single-window facility for the beneficiaries. Such a system must also have cooperative linkages with national and state level developmental agencies, and R & D organisations, besides appropriate administrative organs and NGOs for its continuing development and effectiveness.

Chapter 8, the concluding one, summarises the nature, rationale, findings and conclusions of the present study.

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Sharad Kunjan Tapasvi

August, 1994

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CHAPTER 1

NATURE AND OBJECTIVES OF THE PRESENT INQUIRY

1.1 Introduction

Development intervention in rural areas essentially aims at improving living standards of deprived sections of rural population. An elaborate development delivery system exists to plan and implement various economic, technological, and institutional measures to achieve this end. As a result, significant amount of progress has been achieved in raising the income levels of people below the poverty line. However, a sustained process of development does not seem to have taken shape. The inadequate income earning opportunities; low satisfaction level of felt needs; unsynergistic production processes; and unsustainability of resource use pattern, are clearly visible in most rural areas of India. Even in the Green Revolution areas, where application of modern agricultural technology significantly improved the living standards of people, there are signs of declining productivity, resource degradation, and unsynergistic production. At the micro levels, this crisis in rural India is variously manifested in the forms of high fertility; low life expectancy at birth; deprivation of food, education, health care, drinking water, and sanitary provisions; floods and droughts; deforestation; soil erosion, salinity and alkalinity; water logging; desertification ; urban-ward migration, etc.

The persistence and occurrence of these morally outrageous and socially undesirable life situations raise serious questions about the suitability and appropriateness of rural development planning in India. It has been argued that context-specific requirements as felt by the rural people at the micro level are utterly neglected in plan formulation and implementation. This is clearly visible in the case of selection and management of technologies in bringing about need-based transformation of rural areas. In fact, there are very few evidence of planned change in rural areas where technological solutions are provided on the basis of felt requirements of various social groups. Several evidences indicate that benefits of such development went to the already affluent sections of the population. Regional disparities also got aggravated as a result of the sectoral focus of technological solutions for rural development. Moreover, technologies were used in a fragmentary manner with no transfer of benefits from one domain to another.

Out of several possible factors causing lop-sided development, functioning of organisational forms seems to be the most important factor affecting planning and implementation of rural development programmes. A variety of organisational forms are active for rural development: cooperative societies; voluntary organizations; specialized governmental agencies; public and private sector enterprises; and departments of rural development at different levels of administration. Available evidence suggests that serious organizational problems beset

quite a few of these organizations. For example, the faulty perception of the rural poors' predicament may be because of a highly centralized structure of public development organisations. There may be a tendency in such organizations to respond only to articulate demands for resources. Since these demands are articulated by the well-off and the better organized, development organisations end up exacerbating inequality rather than alleviating it (Gupta, 1989). Similarly, the organisational apparatus may also cause faulty identification of beneficiaries, wrong focus of development programmes, and failure to see evolutionary changes in rural peoples' needs and requirements. It has been argued, therefore, that poverty alleviation programmes need an exclusive delivery system for implementing these programmes. Such a delivery system should have its own recruitment, promotion, reward and punishment system; its own system of monitoring and supervision; and, its own system of organization and management (Bhatt, 1991). The design of development delivery system should, however, be based on a proper understanding of rural peoples' predicament, goals of sustainable development, role of technology, and social organisation in bringing about desired changes.

The present study aims at providing a conceptual and empirical framework to understand the nature of impoverishment at the micro level of a village cluster. This understanding forms the basis for suggesting a technology-based strategy of sustainable rural development in the village cluster. The

strategy involves the identification of relevant technological modules, and design of an organizational apparatus for adoption of the some by intended beneficiaries. Thus, the study basically explores the requirements for technology selection, implementation, and management at the village level.

1.2. Nature of Impoverishment

Etymologically the word impoverishment is derived from the verb "to impoverish" which means to make poor, to reduce to poverty, to take away good qualities. As a process of socio-economic backwardness, impoverishment is witnessed in all societies across cultural and historical epochs. Its nature, however, varies depending upon the socio-economic context, and the natural/physical limits imposed on the availability and use of natural and man-maderesources. Broadly speaking, impoverishment may result in a damaging impact on man's productive capabilities, radically alter his consumption pattern, and distort his value frame. It co-exists with processes of development and transformation (Gallopin et. al., 1989). If the development process is based on increasing exploitation of resources, it gives rise to both affluence and poverty, and at the same time a process of impoverishment sets in, that if unchecked, may damage the long term sustainability of human existence.

Impoverishment processes are operating all over the world, contributing to, and being accelerated by, increasing global

poverty (Gallopin et. al 1989). Whereas poverty is usually seen as a state, impoverishment must be understood in the light of change processes in the social, economic, psychological, and ecological domains of human existence. Thus, modernization, during the last four decades, gave rise to processes of social impoverishment variously manifested in the form of factionalism, social tensions, conflict-ridden organisational structures, distortion of cultural values and indigenous knowledge systems (Banuri, 1990). Impoverishment and deprivation may lead to entitlement failures (Sen, 1981), and failure of certain human capabilities that are important to a person's well-being (Dreze and Sen, 1989). At the psychological level, impoverishment process may cause low levels of need satisfaction and low aspiration levels. It may develop a 'psychology of deprivation' (Sinha, 1982) that diminishes peoples' ability to articulate their demands. Impoverishment in the ecological sphere is characterized by gradual or sudden reduction in the capability of natural environment or some of its components to maintain or increase ecological supply (Gallopin et. al., 1989).

Impoverishment, thus, is a complex and multi-faceted problem. Some of the crucial factors which cause the occurrence and reoccurrence of impoverishment in rural Indian society are : low productivity of land, labour and capital; inadequate income-earning opportunities low levels of basic need satisfaction; unsynergistic production processes; and unsustainability of resource use pattern. The deprivation and impoverishment that

emerges from these interrelated factors is context specific. In other words, there is no uniform pattern of impoverishment in Indian rural society. The intensity of poverty which is being caused by the context-specific nature of impoverishment process, is not taken note of by policy makers. The 'head-count ratio' as an index of poverty, fails to give a clear picture of impoverishment inducing factors at the local level. Even the implementation of various rural development schemes and programmes is negatively affected because of the failure of development organisations to see the context varying nature of rural problems and requirements of desired change. This is mainly because of "top-down" information flow and decision making (Jain et.al., 1985). As a result, the knowledge of the rural people is never considered in rural development planning and implementation, leading to perpetuation of built-in biases against the poor and impoverished. A new development strategy is required that can satisfy rural peoples' needs and also involve them in meeting those needs.

1.3 Sustainable Development as a Strategy for Rural Transformation

Sustainable development refers to a process of change in which the exploitation of resources, the direction of investment, the orientation of technological development, and institutional changes are all in harmony and enhance both current and future potential to meet human needs and aspirations (WCED, 1987). Thus, sustainable development is development that meets the needs

of the present without compromising the ability of future generations to meet their own needs. It implies a pattern of development minimizing or reversing the degradation of the ecological basis of production and habitability. This indicates the primacy of bio-physical resources in sustainable development. This is more so in the case of rural areas where dependence on bio-physical variables is more direct and crucial (Jodha, 1991).

A development strategy that has sustainable development as the normative goal, will aim at maintaining a certain well-defined level of performance over time, and if required, to enhance the same without damaging the essential ecological integrity of the area. Thus, in essence, the sustainability/unsustainability of the transformation process is an outcome of match/mismatch between (i) basic characteristics of the natural resource components, and (ii) patterns and methods of their utilization. The latter can change with the changing needs or perceptions of the community, but the former is normally difficult to change unless the whole resource base is transformed. The inappropriate use of the resource base is a definite step towards long-term unsustainability of the development process.

Given the context varying nature of resource-base and resource use pattern, development process has to start at the local level. It has to be need-based and involve the target population in carrying out development related activities.

1.4 Importance of Technology in Sustainable Rural Development

Technology is a very important means of bringing about transformation in such conditions and processes that are not conducive for human well-being. According to Binswanger and Von Braun (1991), technology and commercialization stimulate agricultural growth, improve employment opportunities, and expand food supply, all of which are central to the alleviation of poverty. The problem of village impoverishment can thus be effectively tackled by application of relevant technologies in activity areas of rural life. When applied appropriately, technologies can : (i) transform production processes and make them more productive; (ii) create more employment and income generating opportunities; (iii) improve quality of life and satisfy the basic needs of people; (iv) bring about synergy in various production activities; and (v) promote sustainability of resource use at the local level.

The crucial factors in a technology - based strategy of rural transformation are : (i) making appropriate technological choices; (ii) selection and introduction of technological packages; (iii) management of technological packages; and (iv) development of appropriate technologies if such technologies do not exist. Supplementing expert knowledge with rural people's knowledge and local cultural ethos is a necessary condition for the success of a technology based development strategy. This appears to be a valid argument as local technical know-how as well as techniques in-use are a part of the cultural milieu which does not exist as

a documented system of knowledge. Rather, such local knowledge is part of the 'techne' of local people which is transmitted and shared by means of symbols, beliefs and values (Marglin, 1990).

The culture specific nature of 'technology system' highlights the importance of local social organisation in the diffusion and adoption of technology package for sustainable transformation and eradication of poverty. It has been argued recently that culturally compatible development apparatus and/or delivery systems are necessary to bring about desired changes in rural areas (Kottak, 1985). A delivery system that uses the local social structure for collective action, is most appropriate for a technology intensive development intervention strategy.

1.5 Need for Technology Delivery System

The benefits of technological application may be targeted towards the poor through social engineering though it may not be easy (Binswanger and Von Braun, 1991). Since instrumentalities for social engineering efforts are organisational, a technology based strategy for sustainable rural development will require an exclusive delivery system and/or development apparatus. The latter requires a set of social actors and a mechanism for managing the process of change induced by the application of the technological packages.

The existing development apparatus has failed to realize the objectives of development programmes (Jain et. al., 1985; Bhatt, 1989, 1991). Apart from their cultural isolation from the

rural milieu, there is practically no freedom given to the frontline staff for making changes or attempt innovations. Participation from the beneficiaries, if any, is nominal and mechanistic. There is neither the culture nor the mechanism for frequent and effective inputs and feedbacks from the grassroot level (Bhatt, 1991).

In such a scenario, a new design of delivery system is required that can empower rural people and encourage them to eradicate impoverishment from their daily lives. Such a delivery system, it can be argued, should be based on the needs of 'technology system' identified for a given area. The context specific nature of the delivery system may be thought of as a culturally compatible design of an organisation.

1.6 Statement of the Problem

The present study is an attempt to provide a framework for technology intensive strategy of sustainable development in an impoverished village cluster. It is posited that if impoverishment is to be checked and reversed in a given rural area, a process of sustainable development must be initiated. Further, the planned strategy for induced sustainable development may be based on : (i) a knowledge and skills (i.e. Technology) intensive approach to development intervention; and (ii) a culturally compatible organisational apparatus for implementing such a strategy.

For micro-level investigations, a village cluster is selected in District Hardoi, Uttar Pradesh. The specific research questions are the following : (i) What is the nature of impoverishment in the cluster ? (ii) Is there any alternative way of understanding and transforming impoverishment inducing factors ? (iii) What are the most important dimensions of this problem? (iv) What could be the technological and organisational solution measures to tackle the problem? (v) Which technological modules are needed to achieve goal of sustainable transformation? and (vi) What could be the most appropriate development apparatus/delivery system for a technology intensive strategy of sustainable development in the chosen village cluster?

In the study, an attempt is made to answer these questions in a synoptic manner. In other words, the study aims at addressing the problem of planned transformation of rural areas from a holistic perspective. It has been argued that planned change can be socially and ecologically sustainable only when it is based on the cultural ethos of the target population. Though culture encompasses the whole value fabric of a society, the emphasis here is on cultural traits related to technology and social organisation of the cluster population. Thus, the present study attempts to explore the context specific requirements of technology selection, implementation, and management. A few modules of synergistic technologies are identified for sustainable development of the village cluster. Finally, a design of

technology delivery system is proposed for meeting requirements of technology transfer in the village cluster.

1.7. Objectives of the Study

The specific objectives of the study are as follows:

(i) to depict the socio-economic and ecological profiles of the village cluster selected for the study;

(ii) to examine on-going rural development efforts in the village cluster;

(iii) to explore and delineate the nature and dynamics of impoverishment and problems of underdevelopment in the cluster;

(iv) to identify policy measures for meeting developmental needs of the cluster's population;

(v) to identify appropriate technological modules for sustainable development in the given cluster;

(vi) to explore the socio-cultural issues relevant for the introduction and management of the identified technological modules; and

(vii) to highlight organisational requirements for technology based strategy for sustainable development in the given context.

1.8 An Overview of the Present Work

Keeping in view the aforesaid objectives, the thesis has been organized into eight chapters. The Chapter 1, i.e., the present one, outlines the importance of technology, and the need for an efficient and effective technology delivery system for sustainable development of impoverished rural areas.

In Chapter 2, the conceptual framework and logical structure of investigation are discussed and elaborated. The socio-economic and ecological profiles of the village cluster are outlined in Chapter 3. The existing development scene and dynamics of impoverishment in the village cluster are examined in Chapter 4. In Chapter 5, cluster-specific problem dimensions, solution measures, and the thrust of development intervention in the village cluster are discussed. The policy measures that constitute the thrust of intervention strategy are shown to be related to selection and management of technological modules and design of the organizational apparatus for technology transfer.

Chapter 6 elaborates the nature and relevance of technological solution measures for sustainable development in the village cluster. An attempt is made to identify a few synergistic technological modules for immediate application in the cluster. In this context, a concept of 'technology atlas' is also presented. In Chapter 7, design of a technology delivery

system is attempted keeping in view certain principles of organisation design. The nature, rational, findings and conclusions of the study are summarized in Chapter 8.

CHAPTER 2

CONCEPTUAL FRAMEWORK AND METHODOLOGY OF THE STUDY

2.1 Introduction

The issue of planned intervention for rural transformation is complex and multi-faceted. It involves a consideration of both socio-cultural and naturo- physical factors in the target area. The present study adopts a systems approach to capture this complexsities.A socio-ecological system is conceptualized that represents the target area for development intervention. The processual nature of impoverishment and development in the socio-ecological system are elaborated and defined. The focus of conceptualization is, however, on 'techno-structural' intervention, a change strategy emphasising the technology and structure of organizations.

The logical structure and methodology of investigation that are required to formulate a strategy of technology-based intervention are also elaborated in this chapter. It has been shown that logical structure and methodology of investigation necessarily follow from the systems approach that provides fundamental orientation to this study. The set of techniques that constitute the methodology, represent a "learning process approach" (Korten, 1980) to problem definition and solution. This methodological approach uses model of a socio-ecological system to explore actors' real world problem situation, the perceptions of their predicament, and possible solutions to specific problem dimensions. The systems approach, thus, links

the conceptual framework of the study with the methodology of investigation.

2.2 The Systems Approach

The planning of change and design of action necessitates a holistic understanding of problem situation. Such a holistic understanding is based on the systemic view of reality. This vision of reality is grounded in notions of interconnectedness and interdependance of all phenomena - physical, biological, psychological, social and cultural (Capra, 1982). It is the whole system with its emergent properties that is seen as real. The reality of the system is intrinsically dynamic and analysed in terms of cyclical, non-linear patterns.

The system approach provides the philosophical, theoretical and methodological bases for understanding this complex and dynamic reality. According to Churchman (1968), the aim of this approach is to spell out in detail what the whole system is, the environment in which it functions, what are its objectives and how this is supported by the activities of the parts.

Thus, this approach involves the inquiry of real or constructed systems. A system may be defined as a collection of interacting elements that function together for some purpose. The functioning of a system creates emergent properties that are properties of the whole rather than of parts. By its nature, the systems approach provides a way of

viewing and interpreting the universe as a hierarchy of interconnected and interrelated wholes. At the same time, this makes it possible to identify and study systems at different levels of hierarchy. This is often necessary when problem identification and problem solution are required in the case of self-organizing systems of behaviour, manifested in the lives of individuals, groups and societies.

It is evident that systems approach is applied in nature. It provides knowledge which may be useful for people involved in solving real world problems. It provides rules of action - rules for the design, control and development of system to be managed.

Many researchers have used systems approach to study "unstructured real world problems." Checkland (1981) develops the concept of "a system which takes purposeful action", a system type called a "human activity system". The study of such systems is useful in understanding situations dominated by the "meanings attributed to their perceptions by autonomons observers" (Checkland, 1981). This, however, requires a Weltanschauung - an explicit perspective with regard to the problem under investigation. Banathy (1988) suggests a simultaneous use of three system models viz., system environment model, structural model, and process of behaviour model to analyse, design and operationlise system of education and development. Gallopin and others (1989) have used systems approach to analyse global socio-ecological impoverishment processes. They use theory of

dissipative structures developed by Prigogine and others (1984) in accounting for processes of self organisation in open, non-equilibirum socio-ecological system.

Among Indian researchers, Rastogi (1978; 1979; 1986a; 1986b; 1987; 1990; 1992a and 1992b) has extensively used systems approach for studying many social, economic and managerial problems. He uses principles of cybernetics to construct multi-feedback loop models for explanation, prediction and monitoring of societal problems. Dastoor (1988) used systems approach and multi-feedback loop model in policy analysis for improving productivity of thermal power plants. Agrawala (1978) employed this methodology in diagonising the problem of sick units in sugar industry.

The systems approach is, thus, used in the study of variety of unstructured real life problem situations. It not only provides a holistic understanding of problem situation but also helps the researcher to identify requirements of remedial actions. The present study employs the conceptual and methodological orientation of systems approach to a micro level analysis of impoverishment process in a village cluster. The analysis aims at evolving an appropriate technologies based intervention strategy for sustainable transformation in the village cluster. The next section deals with the conceptualisation of village cluster as a socio-ecological system.

2.3 The Socio-Ecological Systems

The concept of socio-ecological system provides a unique Weltanschauung for understanding and analysing complex processes of change and transformation in human societies. While there are considerable variations in specific application of this perspective, all recognize the ecosystem - dependence of homo-sapiens and thus deny the notion implicit in mainstream social sciences that modern human societies are exempt from ecological constraints. This perspective, thus, emphasises the importance of examining the relations between human populations and local, as well as, global ecosystems. The future of human societies is seen as inextricably interlinked with the sustainability of these ecosystems.

The application of the idea of ecosystem - dependent nature of human societies in social science researches has inspired both theoretical and empirical studies in fields of human ecology (Duncan, 1961) social ecology (Saint and Coward, 1977; Ashby, 1982 and 1985; Coughenour, 1984) and environmental sociology (Catton and Dunlap, 1978); Dunlap and Catton, 1979a and 1979b); Catton, 1980; Schnaiberg, 1975 and 1980; Dunlap and Martin 1983; Redclift, 1984). The system analysts who adopt socio-ecological perspective in their studies of man-environment interactions, have drawn intellectual and empirical inputs from all the above fields of knowledge. They have attempted a holistic understanding of socio-ecological interactions for providing comprehensive mapping of problems and their solutions (Biswas 1979; Gallopin

et. al. 1989; WCED, 1987; Clark, 1989, Simonis, 1989; Sjoberg, 1989; Lo and Sene, 1989; Menzi et. al. 1989). There is a consensus among these researchers that diachronic and synchronic interactions between social-system and ecosystem are of critical importance in determining the nature and consequences of systemic processes like, impoverishment and development. It is further realized that given the complex nature of socio-ecological interaction processes, sectoral or fragmented methodological approaches are inadequate, both in terms of understanding, and of implementing the necessary action.

These processes are characterised by the following major traits according to Gallopin and others (1989) : the acceleration of the processes of social and ecological change and reorganization; the growing connectedness between social and ecological systems (at the local and global levels); the growing scale and pervasiveness of impacts of human action upon social and ecological processes; increasing global interdependance between nations, and between local and global processes; and the increasing complexity of social, economic and political systems at the national and international levels.

The underlying systemic attributes of these traits of impoverishment and development processes in socio-ecological systems are change and non-equilibrium, connectedness and complexity. In other words, impoverishment and development in socio-ecological systems cannot any longer be reduced to only

economic and material conditions of living. The focus must shift from structural view of poverty and development to the processual view of impoverishment and sustainable development. Thus, there is no either-or situation as far as impoverishment and development are concerned. There is no linear progression from impoverishment towards sustainable development. Both processes can be the part of complex non-liner and self - regulating dynamics of socio-ecological system. The emergent properties, that define the nature of systematic processes, are the result of multiple interactions among the elements of a socio-ecological system. It is, however, difficult, if not impossible, to predict the course of processual change in the system dynamics because of the indeterministic nature of interactions and therefore of emergent properties. However, the pattern of change can be described for a given system's cycling time.

The non-dualistic, non-linear, complex and self organising dynamic operation of socio-ecological system may be understood in terms of the premises of the theory of dissipative structures developed by Nicolis (1977) and Prigogine & Stengers (1984). This theory deals with the processes of self-organisation in systems that are open, flexible and auto-catalytic in nature. The stability and order in such systems is dynamic and must not be confused with equilibirum. The theory was developed to explain phenomenon of self-organisation in chemical systems and has significantly enriched the developments taking place in the

General Theory of Dynamic Systems.

It has been shown by the theory of dissipative structures that transformation and adaptation are part of the same system dynamics. The open, self - organising systems maintain their order by keeping their internal state far from thermodynamic equilibirum, through active exchanges with their environment. Prigogine (1980) has called these system dissipative structure, to express the fact that they maintain and develop structure by breaking down other structures, thus creating entropy or disorder. The entropy in the system is subsequently dissipated in the form of degraded waste products. In the process, these system exhibit characteristic like, self-renewal, adaptation, evolution and self-transcendence.

2.3.1. The Village as a Socio-Ecological System

In the context of the present study, premises of systems approach, and theory of dissipative structures, have been used to conceptualize a village as a socio-ecological system (SES). This consists of two subsystems viz., social and ecological. These are mutually interacting dynamic subsystems, consisting of several elements that may also be connected by cyclical links of actions and reactions. Though, there is a possibility to include many elements in both subsystems, our concern in this study focuses primarily on those elements in social and ecological subsystem of village SES that are most proximate to processes of impoverishment and development in the

system. It is , therefore, suggested that SES consists of elements that are associated with such actions and reactions that lead to manipulation of resources for satisfaction of human needs*. The resources could be natural, human, or man-made. Thus, the eco-system dependence of the village cluster is highlighted. Since these resources are vital for the sustenance and dynamic functioning of SES, it may also be referred to as life-support system (LSS).

The most basic elements constituting social and ecological sub-systems of the village cluster are suggested in Figure 2.1. The figure shows the central fact that both the social and ecological subsystems of the village SES change in response to their own internal dynamics, and to their interactions with one another. Along with the intra and inter-subsystem interactions, certain exogenons sources of change influence the interconnectedness in the system dynamics.

Notwithstanding the complex nature of interactions, it is possible to identify specific details about the system operations in a given situation. Our focus is primarily on three forms of interactions in the SES. The first concerns the set of human actions that impinge on various elements of ecological subsystem. In general terms, the interconnectedness between social

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*The conceptualization of socio-ecological system will vary according to the temporal and spatial dimension under considerations. For details see Gallopin et., al., 1989 and Clark, 1989.

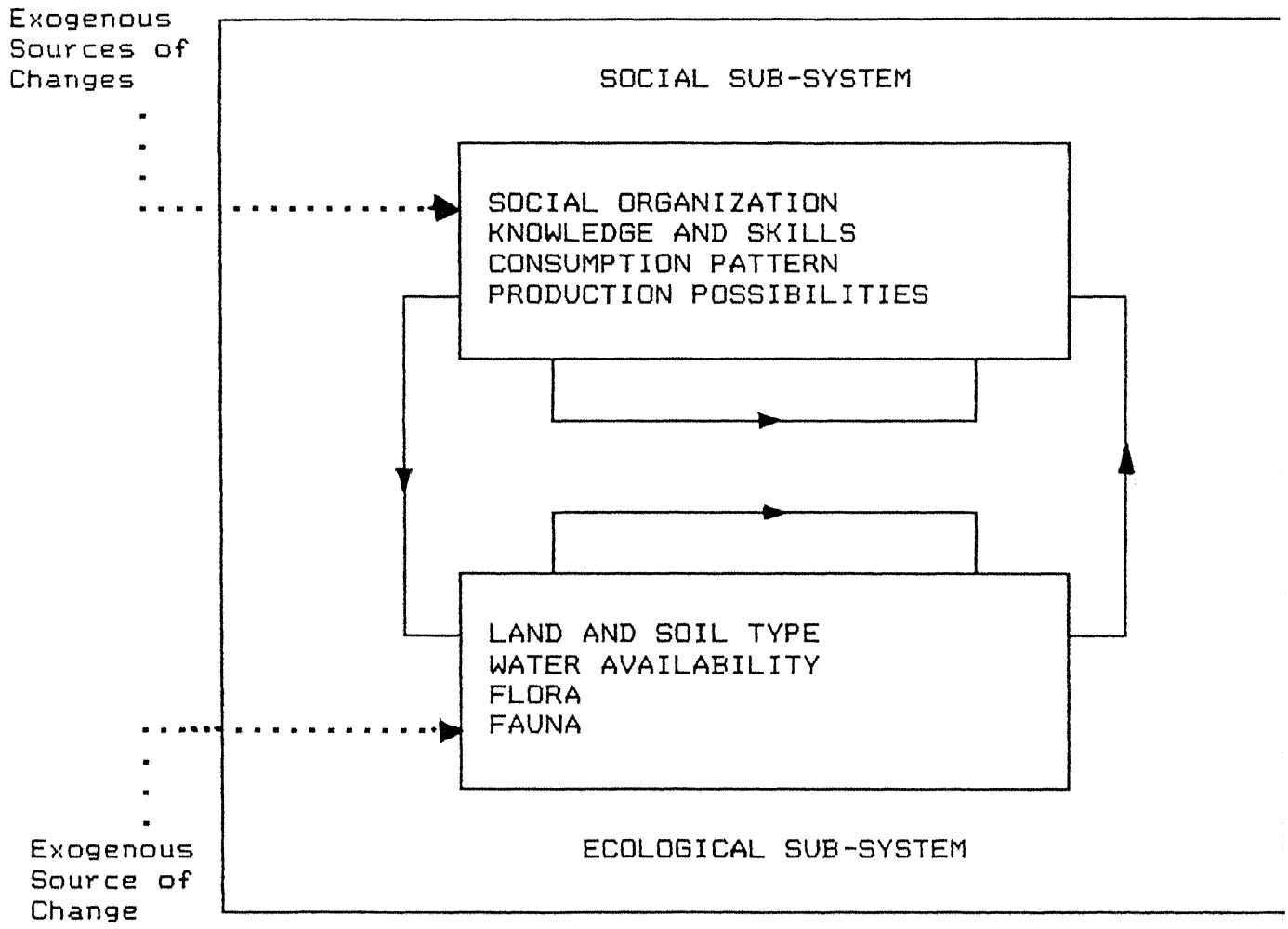

FIG. 2.1 CONCEPTUAL MAP OF THE VILLAGE SOCIO-ECOLOGICAL SYSTEM

and ecological subsystems operate through these human actions. The second concerns the consequences for human well-being that result from climatic, chemical and biotic changes in the ecological subsystem. The third form of interactions that are of utmost concern relate to enhancing human capacities to manage socio-ecological interactions for sustainable development.

The set of human actions that impinge on various elements of ecological subsystem are guided by the demands that groups and individuals make on natural resources. These actions are culture specific and are significantly shaped by values, options and perceptions of social actors (Clark, 1989). The cultural specificity of human actions and choices can be traced from the elements of social ecological subsystems that are shown in Figure 2.1. The choice behaviour further moderates the consequences of environmental changes in the ecological subsystem. The nature of consequences that result from ecological effects generated in nature, are experienced by groups and individuals in terms of risk, exposure, vulnerability and responses (Whyte and Boynton, 1983). These experiences in turn are affected by culture specific values, options, and perceptions. The interactions related to management of change in socio-ecological system is also a culture-specific response. The enhancement of the managing capability can be defined in terms of human ability to increase social choice, and decrease vulnerability in the face of uncertain futures of both environmental change, and human objectives. The efforts

to manage socio-ecological processes involve technologies, institutions and organizational mechanisms.

It is important to emphasise here that all the interactions that take place in SES are part of the same system dynamics. Gallopin et. al., (1989), have used the theory of dissipative self organizing systems (Prigogine and associates, 1984) to explain the operation of socio-ecological system at the global level. We have extended the same for the local village level socio-ecological system. It is conceptually possible because of the temporal and spatial linkages between socio-ecological systems at the global, national, regional and local levels. This multi-level view of systemic reality allows us to identify socio-ecological system at the village level for the purpose of this study. Some of the assumptions about SES that are derived from the theory of dissipative structures are as follows :-

(i) SES is an open system with flexible system boundaries;

(ii) SES is in a state that is far from equilibrium. That is, there is inbuilt instability in the system functioning;

(iii) SES is characterized by adaptive, self-regulating, self organising, self-directing and self- transcending process; and

(iv) SES is, therefore, assumed to have certain performance objectives.

These assumptions have implications for understanding the environment, structure, and processes respectively of the SES. Separate system models may be developed to understand each of these aspects of the SES. The theory of dissipative structures, however, provides a suggestive unifying perspective to relate, explain and subject various elements of SES simultaneously to critical examination. At the same time, the dynamics of SES may be understood in terms of the concepts derived from this theory.

Some of the relevant concepts that explain the processes of change and/or stability in socio-ecological systems are referred to by Gallopin et. al., (1989). These are : Vulnerability, resilience, capacity of response, self-reliance, and adaptations. These five concepts are closely interconnected and help explain three types of interactions mentioned above in the SES of village cluster. A brief explication of each of these concepts in the context of interactions in the village SES, is necessary here.

(i) Vulnerability:

The vulnerability of the system refers to a systemic property related to stability/unstability of its structure. This determines the probability of triggering structural changes by internal or external fluctuations of a given type and magnitude. This is an inherent trait of the system functioning. However it may vary in relation to the nature of

perturbations caused by mutually interacting socio-cultural and ecological subsystems. The increased vulnerability may lead to progress in the system, or it may cause sudden and/or gradual structural degradation of the system.

Several examples may be pointed out to show the prevalence of vulnerability in the SES at the village level. However,one example for each of the three types of interactions in the SES will suffice to make the point clear.

In the case of human actions that impinge on ecological subsystem, we may give example of substantial reduction in soil fertility as a result of over-doses of chemical fertilizers, pesticides and irrigation water. The case of changes in ecological subsystem causing vulnerability in socio-cultural subsystem of SES, is examplified by diseases, low nutritional level, declining productivity, factionalism, etc. Vulnerability further gets manifested in the poor management of crucial socio-ecological interactions in the SES. For example, if problem of wastelands is not dealt with effectively, by technological and organisational means, it may cause massive migration of man-power from the SES, causing shortage of work force for the local production activities.

The concept of vulnerability is, thus, applicable to the total socio-ecological system, and to both the socio-cultural and ecological subsystems of SES separately.

(ii) Resilience :

Resilience* of the system determines the persistence of relationships within a system and is an indicator of the ability of the system to absorb changes in the elements while still persisting. It, thus, refers to the possibility of qualitative changes in the behaviour of multi-stable systems from one basic mode to another. The means and modes for this purpose are technology and organisation respectively.

(iii) Capacity of Response:

This refers to the system's capacity to cope with change. It is applicable to both socio-cultural subsystems and ecological system. The managing of change in socio- ecological system aims at improving system's capacity of responses in the wake of increasing vulnerability and declining resilience.The means and modes for this purpose are technology and organisation respectively.

(iv) Self-reliance :

This is applicable to the socio-cultural subsystem of the SES. It indicates the system's degree of control over interactions with its environment. Thus, a system may be self-reliant in its regulatory functions or may be depending on elements that are external to the system. The development

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*C.S.Hollings(1973) introduced this concept in his studies of ecological systems .He demonstrated that ecological systems are transient and multi-stable . They have two or more stable domains of attractions.Within each domain the state may fluctuate widely (i.e. may be highly unstable), but as long as it stays within the boundariesof the domain, it is resilient.

projects should aim at improving the self reliance of the village SES.

(v) **Adaptation :**

This concept is applicable to socio-cultural subsystem of SES. It refers to the capacity of socio-cultural subsystem to satisfy human needs in the face of changes in the environment. In other words,adaptability represents the capacity of the socio-cultural systems to pursue sustainable development. The changes in interactions between socio-cultural and ecological subsystems may reduce the overall adaptability or may increase it. The emphasis of management efforts should be towards the latter.

2.3.2. Impoverishment and Sustainable Development in SES

Impoverishment and sustainable development are processes of change in the SES. Both can co-exist in the system and are outcome of the dynamics of system functioning. The goal of the system dynamics, however, should be to move in the direction of sustainable development and check the processes of impoverishment. The actual state of the system functioning may just be the opposite. Therefore, the understanding and analysis of the discrepancy between the actual and the ideal will define the problem situation in the system. The conceptual definitions of the two change processes need to be elaborated before such an analysis of problem situation begins.

(i) Impoverishment

The process of impoverishment can be witnessed in both social and ecological sub-systems of the SES. It may take the form of a gradual, cumulative process, or that of a sudden, unexpected collapse of the social and/or the ecological subsystems.

Gradual process of impoverishment is usually perceived as non-threatening, or at least manageable. Thus, malnutrition, disease, high fertility, out-migration, factionalism, fragmented use of resources etc., could be considered as indicators of gradual process of impoverishment in the SES. These are often ignored until they reach unbearable levels. By contrast, sudden and unexpected changes in the social and/or ecological subsystems are viewed as a threat to the human existence. The examples of sudden processes of impoverishment in the SES could be crop failure, violent conflict, epidemic, seasonal unemployment etc.

From the systems perspective, impoverishment in social and ecological spheres indicates growing vulnerability and declining resilience of the system. As a generic concept, impoverishment in social and ecological subsystem is defined as a change process characterized by reduction in the capability of meeting human needs and maintaining supply of natural resources. In the particular case of a local SES, the process of social and ecological impoverishment may have very specific defining characteristics.

The use of system approach in conceptualizing village cluster as SES provides a unified description of total systemic impoverishment, including cases in which amelioration of one social group in one location brings impoverishment to another human group elsewhere. It further helps in understanding the flaws of unsynergistic production processes and their consequences for ecological impoverishment.

(ii) Sustainable Development

The concept of sustainable development refers to a process of development minimizing or reversing the degradation of the ecological basis of production and habitability. According to Gallopin et. al. (1989), sustainable development should meet three criteria : (i) It does not ultimately impoverish one group as it enriches another; (ii) It does not degrade the diversity and biological productivity of the ecosystem, nor the essential ecological processes and vital systems; and (iii) It increases options for self-reliant adaptation.

At the local SES level, sustainable development process should be more oriented towards equitable and sustainable use of bio-physical and human resources in meeting present needs. Furthermore, the major goal should be the inter-generational security in the change process. Thus, sustainable development process in the SES would imply an increase in its capability, and resource base.

We have argued that the goal to increase capability and resource base of SES involves the achievement of the following :-

(i) Employment and Income Generation (EIG);

(ii) Productivity Improvement (PRI);

(iii) Basic Needs Satisfaction (BNS);

(iv) Synergistic Production (SYP); and

(v) Sustainability of Resource Use (SRU).

These goals define the performance objectives of the dynamics of village socio-ecological system.

The activity areas* that constitute the base of sustainable rural development include:

(a) Natural Resources Development;

(b) Rural Infrastructure Development;

(c) Human Resource Development;

(d) Agriculture Development; and

(e) Rural Industries Development.

The specific requirements of each activity area will vary depending upon the dynamics of local SES.

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* Defining sustainable rural development in terms of five activity areas is inspired from Uphoff's (1984,1987) framework for differentiating the rural development activities that require local institutional development.

2.3.3. Means and Modes of Sustainable Development in SES

Location-specific technologies and culturally, compatible organisational apparatus constitute the means and modes respectively, of sustainable development process in the SES.

At the conceptual level, we have defined technology in a broad sense. It includes the total knowledge base, indigenous as well as 'scientific', applicable to a particular socio-ecological system. Unless a synthetic approach of this kind is evolved, the technological intervention may not work as a sufficient means of sustainable development.

The organisational apparatus should also be congruent with the cultural dimensions of social organisation in the SES. As most development programmes require organisational apparatus, designing of an appropriate organisation is a must for sustainable development.

2.4. Logical Structure and Methodology of Investigation

The conceptual frame-work as elaborated above, clearly brings out the orientation of this study. The logical structure of investigation at the field level is derived from the conceptual framework. The methodological techniques that are used to draw conclusions from field observation also follow from the conceptual model. These techniques are integral part of the logical structure of investigation. This, however, does not imply a rigid step-by-step application of the techniques of

data collection. Rather, a "learning process approach"(Korten,1980) has been followed to generate social data for the purpose of the present study. The aim of this approach is to evolve a framework of planned change by combining our perspective with insights of those we study.

The Figure 2.2 outlines the logical structure and methodology of investigation. We start with conceptualisation of the problem from systematic orientation. The empirical investigations involve participatory appraisal at every stage of the field work. Through participatory appraisal, we first draw socio-economic and ecological profiles of the village cluster. In the light of these profiles, a brief appraisal of existing development activities is made. The dynamics of the village impoverishment is delineated next through a multi-feedback loop model. This model serves as the basis for identifying problem dimensions and relevant technological and organisational solution measures. This again involves the use of participatory techniques. The set of policy measures constitute the thrust of development intervention in the village cluster.

The technological means and organisational modes of transformation process define the thrust of developemnt intervention in the village cluster. This also provides a basis for suggesting modules of technolgies and a design of delivery system for desired change in the village cluster. The results of analyses are consolidated at the end in the form of findings and conclusion.

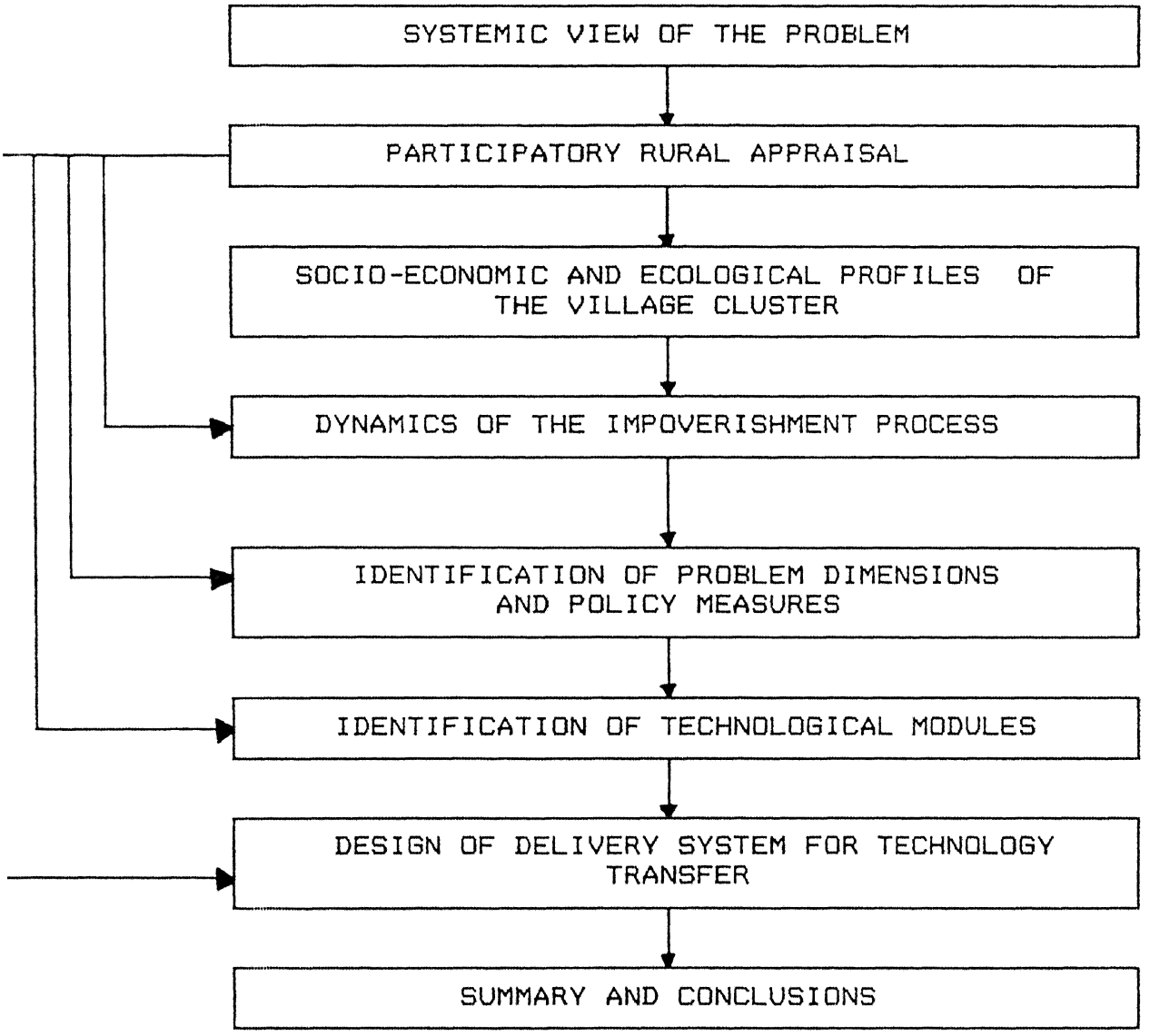

FIG. 2.2 LOGICAL STRUCTURE OF INVESTIGATION

The methodological techniques used in the logical structure of this study are briefly elaborated as below.

2.4.1. Participatory Rural Appraisal (PRA)

It has been argued that realities of rural deprivation are often missed during questionnaire surveys and statistical analysis . They limit investigation to what can be asked and what can be counted (Chambers, 1983). As an alternative, Chambers and his associates in the Institute of Development Studies at Sussex, U.K., have suggested a set of operational procedures to carry out PRA* . They include searching for and using existing information; identifying and learning from key informants; direct observation and asking questions about what is seen; guided interviews and group discussions with informal, selected groups. In the context of designing rural development projects, the use of these techniques has a fundamental dictum, that is, the people who are affected will decide what is to be done for their betterment.

Thus, the use of PRA involves 'reversals in learning.' However, this has its own rigour and values. According to Chambers (1985), two key elements to successful PRA are 'optimal ignorance' and 'appropriate imprecision.' Optimal ignorance is the measure of courage necessary to concentrate on selected

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* When the use of these technique first started in late 70s by the a team of researchers from IDS, University of Sussex, these were referred to as Rapid Rural Appraisal (RRA)techniques.

socio-cultural indicators with demonstrated operational significance, rather than trying for comprehensive coverage of the ethnography of the local area. Appropriate imprecision is the measure of detail which is or is not needed about an area. Researchers should collect only enough information for their immediate purposes.

In this study, we have used PRA techniques in a composite manner to generate social information about socio-economic and ecological profiles of the cluster; suitability of existing development programmes and lacunae in them; problem dimensions and policy measures; nature of technological modules; and structure, functions, processes, and objectives of organisational apparatus for technology transfer.

2.4.2. Multi-feedback Loop Model

Since, village cluster has been conceptualized, in this study, as socio- ecological system, we need a method that can analyse problem situation in SES in a holistic manner. Social Cybernetic approach to the analysis of problem situation is one such method*. It analyses a problem comprehensively in terms of the interconnectedness of its various variables. The dynamic nature of the problem situation is represented in the form

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*For details see Rastogi (1992) on the development and use of this methodology.

of a set of interacting negative and positive feedback cycles *. Several such cycles produce a multi-cycle structure of the problem situation. This shows problem's changing behaviour and symptoms over time.

The methodology can be used for both generalized theory construction and particularized representation of a real life problem situation. Moreover, it unifies together the descriptive, explanatory, diagonistic, normative, predictive and ameliorative aspects of a phenomenon or problem situation (Rastogi, 1992).

In the context of the present study, however, we have used multi-feedback loop model of village impoverishment as a location specific representation of the problem situation. Furthermore, the model has been used only for descriptive and explanatory purposes. Salient variables of the model serve this purpose by representing the state of the system in a synoptic manner.

2.4.3. Identification of Problem Dimensions and Policy Measures

Salient variables of the multi-feedback model provide the vantage point for identification of cluster -specific problem dimensions and relevant technological and organizational

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* A negative feed-back cycle indicates a deviation-reduction function of interconnected variables. The positive feed back cylce, on the other hand, indicates a cumulative desired change in interconnected variables. In real life situations, feed-back cycles may malfunction and therefore deviate from their 'intended regulatory role' in the system.

measures for solving them. The latter constitute the set of policy measures for achieving goal-state of problem solving.

The identification of policy measures define the thrust of intervention strategy in the village cluster. PRA techniques are used to disaggregate salient variables of impoverishment for identifying various problem dimensions and corresponding policy measures.

2.4.4. Technological Modules and Organisational Apparatus for Technology Transfer

The nature and relevance of technological policy measures are discussed in terms of their suitability to five activity areas for sustainable rural development. The mutually supportive or synergistic relationships among these technologies were explored in terms of their appropriateness to achieve one or more goals of sustainable development in the village cluster. The nature of technological modules is deduced on the basis of these supportive linkages. The group discussions among villagers, interviews with area experts, and field observations formed the sources of information for working out mutually supportive relationships among technologies, identified as possible solutions measures. The socio-cultural issues in transfer of technological modules are also identified on the basis of the socio-economic profile of the village cluster.

The dimensions of designing organizational apparatus/delivery system for technology transfer are identified

and elaborated in the context of the village cluster. A meta-level sociocultural principle for organisation design is also proposed keeping in view the necessity of a culturally compatible delivery system for technology transfer and implementation.

2.5 Summary

In this chapter, the conceptual framework and logical structure of investigation are elaborated. The fundamental orientation of both is derived from systems approach. The techniques of data collection and analysis enjoin the principle of systemic learning process. The aim of this conceptual and methodological orientation is to achieve holistic understanding of problem situation and evolve a most suitable technological intervention strategy for sustainable development in the village cluster.

CHAPTER 3

SOCIO-ECONOMIC AND ECOLOGICAL PROFILES OF THE VILLAGE CLUSTER

3.1 Introduction

The conceptualisation of the village cluster as socio-ecological system (SES) provides the basic orientation for its empirical description. The elements of the two subsystems of SES are empirically examined in this chapter for depicting the socio-economic and ecological profiles of the village cluster. This is the first step towards analysis and understanding of the problem of impoverishment, and under-development in the present context. In addition, these profiles give us an idea about the 'why' of a strategy of sustainable rural transformation in the village cluster.

In this chapter, we first provide an overview of the village cluster selected for the study. This is followed by detailed accounts of socio-economic, and ecological conditions prevailing in the cluster. In the end, a summary of the discussion is provided.

3.2 GAJU : The Village Cluster in Hardoi, Uttar Pradesh

Hardoi is one of the most under-developed districts in central Uttar Pradesh. The total geographical area of the district is 59866 sq. km. As per the Census 1981, the total population of the district was 22,74,929.* Out of this, the

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* The total population of Hardoi in Census 1991 is 27,39,003. This indicates an absolute increase (1981-91) of 464074 and percentage decadal variation in population as 20.40 per cent. The details of Census 1991 are not yet available.

rural population density increased from 380 per sq. km., in 1981 to 458 per sq. km. in 1991. The sex ratio marginally declined from 827 in 1981 to 819 in 1991. The total literacy rate of the district is 29.46 per cent as per the Census 1991. The district falls in the lowest rating category of Uttar Pradesh.

The total working force in the district as per Census 1981 was 6.93 lakh or 30.45 per cent of the total population. Of these, 87.14 per cent are involved in agriculture as owner cultivators, share-croppers, and agricultural labourers. This reveals that a large section of the district's population depends on agriculture for livelihood.

There are four sub-divisions, and nineteen community development blocks in the district. The village cluster selected for the present study is in Kachauna Block. Kachauna is situated in the south-eastern part of the district at a distance of 35 km from Hardoi beside the road going toward Lucknow, the capital of Uttar Pradesh. Kachauna is a town area and has all the basic civic amenities like PHC, post office, banks, market, transportation, telephone, police station, etc. There is a railway junction - Balamau - at a distance of 2 km. from Kachauna, that connects it to cities like, Delhi, Kanpur, Lucknow, Sitapur and Hardoi. In terms of population and area, Kachauna is smallest development block of the district. The total area is 254 sq. km. and population as per Census 1981 is 91,690,*

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* The population figures of the Blocks are not yet available for Census 1991.

of these, the population of socially and economically disadvantaged groups, referred to in the Constitution of India, as Scheduled Castes, is 41,293 which is about 45 per cent of the total population. The total literate population is 16,471 and crude literacy rate works out to be roughly 18 per cent. The total working population in the Block is 27,660 which is about 30 per cent of the total population. Of these, the population of cultivators including share-croppers is 23,297 and that of agricultural labourers is 2041. Thus, the total working force engaged in agricultural sector is about 92 per cent. A small fraction of the work force about 2.6 per cent, is engaged in family business. Thus, agriculture is the main source of livelihood for a major part of the population in Kachauna.*

It was, however, discovered that agricultural operations in Kachauna are quite unsustainable. One of the major reasons of this is the highly alkaline soil with pH value varying from 8.5 to 11.0.** As a result, there are about 2096 hectare of wasteland in this Block. The total sown area is 18,320 hect., out of which 14,134 hect., is the net sown area used for single cropping. Only 4,186 hect. is under double cropping. The per capita food grain production in 1986-87 was 344.7 kg., which is marginally above the district average, i.e., 315.0 kg. Apart from the alkalinity of soil, other reasons suggested for unsustainable agriculture are:

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* All the figures are from Statistical Diary of Hardoi, 1988.

** Source: Regional Agriculture Testing and Demonstration Centre, Hardoi.

lack of assured irrigation; poor availability of inputs; high costs of modern agricultural practices; inadequate and inefficient services provided by government departments and agencies. The majority of the people are involved in agriculture because there are very few other means of earning income. Many people in the working age group migrate to cities like, Lucknow and Kanpur which are very well connected through rail and road transports. During the agricultural lean seasons, villages are found deserted. This indicates a high incidence of seasonal unemployment in the villages of Kachauna.

There are 46 revenue villages in Kachauna. For purposes of local self-government, these villages are organised into 43 Gram Sabhas*, each having an elected body called Gram Panchayat consisting of a Pradhan, his/her deputy and a few members. The secretary of each Panchayat is a village level government functionary called Gram Panchayat Adhikari who keeps the records of Panchayat functioning. The development work in each Gram Sabha is supervised by a village level extension functionary called Gram Vikas Adhikari.

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* Gram Sabha is a cluster of villages (hamlets) which have a common elected Panchayat. For all government sponsored development work, Gram Sabha is treated as a unit. Recently, by a Constitution Amendment Bill (73rd Amendment), Government of India has made statutory provisions for holding Panchayat and other local bodies elections every fifth year, in addition to decentralisation of financial, planning and other functions.

For the purpose of the present study, Gram Sabha GAJU was selected to carry out intensive field investigations and participatory rural appraisal. The decision to select GAJU as study area can be mainly attributed to a piece of information given by District Development Officer (DDO) of Hardoi. It was learnt from him that four Gram Sabhas of Kachauna Block had been identified for implementation of central government sponsored Wasteland Reclamation Scheme. GAJU was one of them as it has large salt affected land with pH value more than 9.00. The scheme involved the use of a technological package to transform agriculturally useless land (Usar) into land useful for productive agriculture. It was thought that it would be a good opportunity to observe as to how people react to such technology - intensive development scheme. Moreover, since too much importance was attached to the scheme by district administration, it was felt that field study in GAJU would help understand the functioning of development delivery system in a better way.

The preliminary field work was done in GAJU during the summer of 1990 from April to June. Later on, short duration visits were made to hold group discussions for identifying specific problem dimensions, technological solutions and organisational requirements. Before starting the preliminary reconnaissance, a copy of village map was acquired from sub-division office at SANDEELA. The records of land-ownership and common property resources were also reviewed. In addition, the

village Economic Register of GAJU, maintained by Gram Vikas Adhikari, was also consulted.

GAJU and its hamlets are situated at a distance of five to six kilometers from the block office at Kachauna. There is a brick road upto GAJU but other hamlets are linked through narrow, dusty walkways. The brick road upto GAJU is quite inconvenient for motorized transport. The most common modes of conveyance are bicycle and bullock-cart. Occasionally, one may see motor-cycle, jeep or tractor on his way to the village cluster. The majority of the villagers including women and children walk down upto Balamau and Kachauna on weekly market days.

There are ten hamlets in GAJU Gram Sabha. The number of households in the cluster is 680 and total population is 5,677. The number of males and females are 3,042 and 2,635 respectively. The literate population is 926 out of which 846 are males and 80 are females. There are 2,565 people who belong to Scheduled Castes and constitute 45 per cent of the total village population.* The hamlet-wise distribution of households and respective population is given in Table 3.1.

Each hamlet in the cluster is regarded as a village by local people. For purpose of local governance, however, all of them are clubbed into a cluster known as Gram Sabha. The hamlets are not inhabited by exclusive social groups. In fact, except in Darshan Khera where all inhabitants belong to a single caste group, other hamlets are inhabited by several caste groups. All men and women

Table 3.1

Number of Households and Size of Population in Hamlets of the Village Cluster

Sl.No.	Name of Hamlet	No. of Households	Size of Population
1.	Gaju	247	1976
2.	Bahadin	123	1004
3.	Gothava	128	1074
4.	Jhariai	20	203
5.	Phattepur	48	384
6.	Shankar Khera	15	156
7.	Darshan Khera	40	358
8.	Mahipal Khera	17	156
9.	Narpatt Khera	24	212
10.	Punjabi Khera	18	154
	Total	680	5677

* Source: Economic Register of Gaju ((1986-1991). This is maintained by Gram Vikas Adhikari who updates it every fifth year. The population figures, however, are from Census, 1981.

aged 18 years or above have voting right to elect members to Gram Sabha's executive body, known as Gram Panchayat. In GAJU, the Gram Panchayat consists of 19 members including a Gram Pradhan and his deputy. In recent years, the position of Gram Pradhan has become very significant because he/she takes major decisions in consultation with other members of the Panchayat, about the execution and implementation of Jawahar Rojgar Yojana (JRY), the funds for which are directly given to him/her. The selection of the beneficiaries is also done in general body meeting conducted by Panchayat office bearers. These developments have generated lot of interest among villagers about Panchayat activities and as a result the factionalism among social groups

and their polarization has become a common phenomenon in village life.

Some additional informations about households found in the Economic Register of GAJU are given in Table 3.2 and Table 3.3.

Table 3.2 shows the number of households in three income categories. This information is required for selection of beneficiaries for various government sponsored development schemes.

Table 3.2

Classification of Households in terms of Annual Income (in Rs.)

Sl.No.	Income Category	No. of Households	%
1.	0 - 4800	351	51.6
2.	4801 - 6400	174	25.6
3.	6401 >	155	22.8

The above table shows that more than three-fourth of the households in the village cluster are below poverty line (i.e. Rs.6400/- p.a.) fixed by the government. This is an objective indicator of the situation of poverty. Table 3.3 classifies the total number of household in terms of the categories of agriculturist and non-agriculturist.

It is apparent from Table 3.3 that majority of the households that are engaged in agricultural activities are either marginal farmers, small farmers or agricultural labourers. The members of the non-agricultural households are either in

Table 3.3

Classification of Households in terms of Involvement/ Non-involvement in Agriculture

Sl. No.	Agriculturist/ Non-agriculturist	Number of Households	%
I.	Agriculturist		
a)	Big Farmer (3 Hect. >)	35	5.1
b)	Medium Farmer (2-3 Hect.)	63	9.3
c)	Small Farmer (1-2 Hect.)	110	16.2
d)	Marginal Farmer (< 1 Hect.)	325	47.8
e)	Agricultural Labourer	125	18.4
II.	Non-agriculturist	22	3.2
	Total	680	100.0

government service or engaged in petty family business. The data about agriculturist households, however, presents a very sorry state of affairs in the village cluster. There is no denying the fact that large section of cluster population is merely engaged in subsistence form of agriculture.

In addition to above informations given in Village Economic Register, some more data were gathered from key informants' interviews.* Table 3.4 shows these household-wise data which are based on key-informants' accounts. These informations give us a fairly good understanding of the nature of households in the village cluster.

Table 3.4

Nature of Households in the Village Cluster
(Total number of Households = 680)

Sl. No.	Attribute Defining Households	Number of House-holds	%
1.	Women-headed Household	25	3.7
2.	Totally illiterate households	432	63.5
3.	Totally literate household	42	6.2
4.	Households involved in Cooperative Society	17	2.5
5.	Households which do not own live-stock	148	21.8
6.	Households owning Tractor	0	0
7.	Households owning Thresher	2	0.3
8.	Households having assured means of irrigation	33	4.9
9.	Households owning mud and thatch houses	574	84.4
10.	Households having no means of conveyance	407	59.9
11.	Electrified households	2	0.3
12.	Households having Biogas plants	2	0.3
13.	Households having access to safe drinking water	393	57.8
14.	Households having clean toilet facility	21	3.1

* Key informants were Gram Vikas Adhikari and a few local educated youth involved in agriculture as well as employed in government service.

An overview of the land resources, irrigation facilities, and other amenities in the village cluster is presented in Table 3.5.

The data presented in this section reveal the under-developed status of the village cluster. It is clear that the processes of transformation induced by government sponsored development intervention has not led to self-sustaining growth in the village cluster. These data are however not sufficient to comprehend the socio-ecological factors that make it difficult for the policy makers to understand the complex nature of poverty and

Table 3.5

Secondary Data about the Village Cluster

1.	Total Area	: 1353 Hectares
(i)	Common Property Land	: 395 Hectares
(ii)	Area available for Agriculture	: 554 Hectares
(iii)	Area not suitable for Agriculture	: 404 Hectares
2.	Irrigation	
(i)	Area under irrigation	: 255 Hectares
(ii)	Unirrigated Area	: 299 Hectares
(iii)	Main source of irrigation	: Canal and Ponds
3.	Basic Amenities	
(i)	Whether hamlets electrified	: Yes
(ii)	Railway Station	: Balamau
(iii)	Bus Stop	: Kachauna
(iv)	Post Office	: Yes
(v)	Primary School	: 3
(vi)	Junior High School/High School/High Secondary	: No
(vii)	Mother and Child Care Centre	: Yes
(viii)	Dispensary/PHC	: Kachauna
(ix)	Cooperative Service Society	: Yes
(x)	Fertilizer Store	: No
(xi)	Seed Store	: No
(xii)	Pesticides Store	: No
(xiii)	Veterinary dispensary	: Kachauna
(xiv)	Assured source of Irrigation	: No
(xv)	Storage Facilities	: No
(xvi)	Grain Market	: Balamau
(xvii)	Banks, Cooperative Bank, Gramin Bank	: Kachauna
(xviii)	Cottage Industry	: No
(xix)	Police Station	: Kachauna
(xx)	Metalled Road	: No

impoverishment in the village cluster. Therefore, the socio-economic, and ecological profiles of the village cluster need to be elaborated before dynamics of impoverishment can be explained.

The following two sections describe socio-economic and ecological profiles of the village cluster. Since PRA methods were used to draw these profiles, no rigid sampling method was required to sample individual respondents or households. These methods enjoin as large participation of the people as possible.

3.3 Socio-Economic Profile of the Village Cluster

The socio-economic profile of the village cluster describes the four elements of socio-cultural subsystem viz., social organisation; knowledge and skills; consumption pattern; and production possibilities. These elements are culture-specific and largely depend on the norms and values of a society. Due to this embeddedness, the factors of social change, both exogenous and endogenous, do not affect these elements in a linear fashion. For example, the nature of social organisation does not change from say, traditional to modern because of the introduction of adult franchise in elections. Similarly, the introduction of modern technology does not eliminate the use of traditional knowledge and skills by social actors. The change is, in fact, always accretive and leads to the reproduction of values and social collectivities in new forms. This peculiar dynamics of socio-cultural subsystems should always be taken note of, while exploring the nature of different elements in the given context. This is all the more significant because it may be strategic to convert traditional values and solidarities into "resources" in the planning of sustainable development. The use of prevalent social base (reflected in the nature of its elements) as the axis of planned

change may convert the existing primordial collectivism into instrumental collectivism (Oommen, 1977).

The depiction of culture-specificity of the four elements of socio-cultural subsystem here aims at providing the crucial socio-economic inputs to the planning of technology-based intervention strategy for sustainable development in the village cluster.

3.3.1 Social Organisation

Social organisation refers to the ways a society is organised - the interrelationships between different groups and institutions, patterns of hierarchy, aspects of leadership - and the ways ideas, messages and innovations are introduced and communicated. The understanding of these aspects of the existing pattern of social organisation in the village cluster provide a key to the design of delivery system for implementation of technology based strategy of planned change.

For an outsider, it is difficult to comprehend the complex social organisation of a society. It was largely because of the close rapport with Gram Vikas Adhikari that we began to understand organisation of social life in GAJU and its hamlets. In the very first week of our visit to hamlets of the cluster, it became clear that village social life was organised around several caste groups. The name of castes and respective number of households are given in Table 3.6.

Table 3.6

Caste Groups and Number of Households in the Village Cluster

Sl. No.	Name of Caste	Number of Households	%
1.	Badai	13	1.9
2.	Bania/Kalwar	18	2.7
3.	Bhurji	6	0.9
4.	Brahmin	34	5.0
5.	Chamar	105	15.4
6.	Darji	5	0.7
7.	Dhanuk	2	0.3
8.	Dhobi	12	1.8
9.	Gadaria	10	1.5
10.	Gaddi	45	6.6
11.	Kasai	5	0.7
12.	Kayastha	1	0.2
13.	Kumhar	15	2.2
14.	Lohar	6	0.9
15.	Maurya	20	2.9
16.	Mehtar	10	1.5
17.	Nai	20	2.9
18.	Manihar/Kahar	12	1.8
19.	Pasi	210	30.9
20.	Punjabi *	18	2.6
21.	Raidas/Fakir	28	4.1
22.	Teli	10	1.5
23.	Thakur	20	2.9
24.	Yadav	55	8.1
Total		680	100.00

* Punjabi is not a caste but is known as a distinct social group in the cluster because they are migrants from rural Punjab and are settled in the cluster by Government's assistance. They are also most enterprising among all social groups.

The caste groups of the village cluster are ritualistically segregated collectivities. The intra-caste relationships revolve around the value of sociality which implies linkages between persons and groups not only as means but also as ends. This helps maintain caste solidarity which gets reflected into members' socio-political behaviour. It was noticed that though hamlets of the village except Dharshan Khera, are not inhabited by single

caste households, within the hamlets, the houses are clustered in different localities on caste lines. In Dharshan Khera, members of all 40 households belong to Pasi caste (one of the many lower castes) and are involved in piggery and illicit liquor making - occupations considered as impure by other caste groups. Since, Pasi caste forms the numerically largest group in the cluster, the members do not feel insecure and maintain their social identity in the village social organisation.

The inter-caste relationships are guided by the value of hierarchy determined by the ritualistic purity and impurity of caste groups rather than by the value of sociality. Thus, Brahmin and Thakur castes figure on top of the hierarchy while Chamar, Dhobi, Dhanuk, Mehtar and Pasi fall in the category of low castes. Rest of the castes fall in the middle of the hierarchy. The element of hierarchy in the inter-caste relationships has, however, considerably weakened in the changed social, economic, and political environment. The factors which influence these relationships are now related to ownership of arable land, economic prosperity, and numerical strength. The influence of these factors gets reflected into new boundaries of social behaviour; pattern of domination and subordination; and group alignment and factionalism. Thus, quite predictably, the Thakurs who own most of the productive lands of the village, have to depend on Pasi, Chamar, and Gadaria households for agricultural labour. The members of the latter now demand either cash wages or at least half share in the total produce. Gaddi and Yadav

caste members who have achieved economic stability by virtue of their involvement in remunerative animal husbandry and government service respectively, challenge traditional domination of Thakurs in the village social organisation. The members of Pasi caste are politically significant because of their numerical strength and are courted by Thakurs who are desperate to maintain their dominant status in the changing politico-economic situation in the village cluster. The Gaddi and Yadav caste members are politically weak in the local power structure and therefore are hostile to Thakurs on several occasions. The Thakur caste gets the support of lower castes because of the latter's economic integration with the former.

The factionalism normally remains dormant. But, at the time of Panchayat elections, Gram Sabha meetings, and selection of beneficiaries for development assistance, inter-caste tensions become very apparent. The members of other caste groups who are involved in caste-related professions do not take much interest in faction politics. They are however drawn into the factional feuds at the time of elections causing considerable social tension in the cluster. The Punjabi group that is treated as "outsider" has generated envy among rest of the caste groups because of their enterprising nature and resultant economic prosperity. It clearly appears that in the inter group relationships, the ritualistic caste hierarchy has given way to politico-economic influences as axes of social association. In intra-group relationships, on the other hand, the aspects of caste sociality still plays a

significant role in maintaining the social identity of groups.

The pattern of local leaderships is also shaped on caste lines. Every caste group has one or two such members who can be considered as local caste leaders, though no such label is attached to them. Such persons are respected by other members, who regard them as those who are full of wisdom. They are heard by fellow caste members at the time of actual or potential social disturbances. The 'normal' life goes on in the cluster unless a threat is anticipated to cultural identity of one or more caste groups. The caste, thus, continues to be a basic cultural means for social organisation in the village cluster.

3.3.2 Knowledge and Skills

The indigenous knowledge and skills act as "resources" for problem-solving and define the prevailing technological base of a given socio-cultural subsystem. Various aspects of this element of culture are not always found in documented form and their acquisition is part of the process of socialization and social learning. These aspects get reflected into several myths, sayings, anecdotes, and stories which are integral part of the socio-cultural behaviour of social actors.

It is however not very easy to understand, and document locally available knowledge and skills. The key to incorporate and use this knowledge base, in the planning for a technology-based strategy of induced change, is to encourage social actors'

participation in problem identification and problem-solving process.

In the context of the village cluster, it was noticed that villagers had the knowledge of several requirements for their predominant mode of making livelihood. For example, those who are directly engaged in agriculture whether as owner-cultivators or share-croppers had the knowledge of soil types and their productive potential; moisture requirement of various crops; use of local flora; potential damages from different varieties of local fauna; climatic trends; quality of seeds and related requirements; expected yields from different size of holdings; fertilizer requirements for crops, etc. Those who are engaged in other activities like animal husbandry, sheep rearing, piggery and horticulture, are quite aware of the problems and prospects involved in their respective activities. The knowledge and skills for the use of local building materials, agricultural implements, tools, etc., are quite well-known to the majority of the villagers. However, those who belong to higher caste and are not directly involved in manual work, are not aware of the several aspects of locally available knowledge and skills. They depend on others who can provide services related to agriculture, animal husbandry, construction of houses, etc. The use of a locally available knowledge and skills is regarded as convenient and dependable by most of the villagers approached for discussion.

During the field work, an attempt was made to develop a glossary of local technical knowledge through group discussions

with villagers. This was most frustrating experience for us. The participants in group discussions did not understand the questions regarding the use of technologies in meeting their needs. However, when they were informed about the potential of some of the technologies that could affectively tackle some of the problems narrated by them, they showed keen interest in the discussion. Quite a few of them, particularly the young ones expressed their willingness to adopt new technologies provided these do not involve risks, are cheap, and easily made available to them. The older ones, however, were skeptical about the utility of modern technologies and expressed more reliance on traditional methods. Interestingly, some of the participants who belonged to upper caste groups opposed the technology-based approach to the development in the village. Probably, they felt that if such a strategy was successful, they would loose their social power.

3.3.3 Consumption Pattern

The local consumption pattern is an important element of socio-cultural subsystem and is closely related with the nature of the needs of various social groups, and their satisfaction in a given socio-ecological context. Therefore, rather than focusing our explorations on actual consumption levels, we attempted to categorize villagers' felt needs in terms of activity areas relevant for sustainable rural development. This gives us a preliminary idea of development priorities in the cluster.

In the village cluster, remarkable similarities were noticed in the perception of needs and requirements by members of different social groups. There were few variations because of different income levels and occupational involvements.

The needs for infrastructure development like, roads, transport, electricity, drinking water, and sanitation were voiced by several participants in the group discussions. Similarly, the needs for human resource development like, medical facilities and better primary education facilities were also expressed by all the sections of the village population. It was clear during the group discussions that these needs remain unfulfilled in the case of majority of the households.

In the case of natural resource development again, the participants in group discussions voiced their need for improved irrigation facilities, wasteland reclamation, constant availability of domestic fuel, and fodder for the livestock. Except the big land owners, other villagers felt that their privately owned sources to meet these needs are inadequate, and unfulfilled nature of these needs make their lives very difficult in the village.

The nature of needs related to the agricultural and rural industries development depend on the income levels and occupational involvements of the participants. While the needs for inputs required in crop production, animal care, and horticulture were voiced by several participants, there were very few who felt that there was a need to improve sheep rearing, piggery, and poultry related income earning activities. The need

for rural industries development in the form of processing units was also felt only by a very few participants.

3.3.4 Production Possibilities

Production possibilities refer to the expansion and diversification potential of economic activities in the socio-cultural and ecological context of the village cluster. The exploration of these possibilities, in the present context, is based on the assessment of currently undertaken production activities by different sections of the village population, and the latter's willingness to start new income-earning activities.

A listing of currently undertaken income earning activities, observed deficiencies, and social actors' responses are summarised in Table 3.7.

Table 3.7

Existing Economic Activities in the Village Cluster

Economic Activity	Number of Households engaged	Observations	Responses of Social Actors
Agriculture	15	Big land-lords from Thakur caste	Costly inputs. Give land to share cropping
Animal Husbandry	18	Belong to Gaddi Caste, sell the the milk in nearby towns	Want better animal care facilities
Piggery	7	Belong to Pasi Caste	Indifferent
Sheep Rearing	3	Gadaria Household	Indifferent
Wage Labourer	60	Lower caste households	Want to own some land in the village
Government Service	10	Belong to Yadav caste and are economically well-off	Want better infrastructure in the village

Table 3.7 (contd.)

Agriculture & Husbandry	107	Small farmers involved in share-cropping and do husbandry as allied activities. Punjabi households are quite successful in both activities	Want to improve their conditions
Agriculture & Piggery	2	Pasi share-croppers	Want to improve their conditions
Agriculture & Sheep Rearing	3	Gadaria Household doing share cropping	Want to improve their conditions
Agriculture & Wage Labour	61	Marginal farmers who do work for cash income	Prefer to migrate to urban centres for work
Agriculture & Government Service	9	Largely agriculturist household where one member is in Government service. Quite prosperous	Want to expand their agricultural activities
Agriculture & Profession	1	Thakur household where one member is a lawyer	Want to expand agriculture activities
Agriculture, Husbandry and Wage Labour	147	Small farmers who supplement their poor income by other activities	Not happy with their conditions
Agriculture, Piggery and Wage Labour	1	Pasi share cropper, as well as, wage labourer	Wants to improve his condition
Agriculture, Government Service and Husbandry	24	Yadav households which own land, as well as, cattle for personal use	Want to expand their agricultural activities
Husbandry & Wage Labour	169	Marginal farmers whose lands are not productive at all	Want to improve their conditions
Husbandry & Petty Business	14	Bania households which keep cattle	Husbandry for personal use
Husbandry and Government Service	21	Government servants who keep cattle for personal use	Contended
Petty Business	4	Bania households	Economically secure
Caste Related Work	4	Quite poor	Indifferent
Total	680		

:: Data on the currently undertaken activities are collected from the informal discussions with villagers at several locations.

On the basis of above table, it may be deduced that in the village, there is enough expansion potential in agriculture, animal husbandry, sheep rearing, and piggery. These activities are currently being undertaken by majority of the sections of village population, and if efforts are made to provide adequate support the villagers may acquire permanent sources of employment and income.

In addition, some other income generating activities may be started in the village, for which conditions are suitable. According to a few area experts in the district, following employment and income generating activities are most suitable for the village cluster:

1. Sericulture
2. Horticulture
3. Floriculture
4. Poultry

These activities may be adopted by small and marginal farmers of the village cluster. Those who do not own land, may start poultry which is highly remunerative - like animal husbandry.

It may be pointed out here that the success of the expansion of current production activities and initiation of new ones will largely depend upon beneficiaries motivation; availability of resource; training support; and storage, packaging and processing facilities. The favourable ecological conditions are also

important requisite for the success of these production possibilities in the cluster.

3.4 Ecological Profile of the Village Cluster

Before embarking on participatory appraisal of ecological conditions of the village cluster, relevant literature was referred for delineating boundaries of our discourse with key informants and villagers.

It was learnt that being in Central Uttar Pradesh, district Hardoi falls in Upper Gangetic Plain Region. Since this is an all-India category of agro-climatic zone, it was difficult to find specific problems and precise guidelines for ecologically sustainable development in Hardoi. A more homogenous classification of agro-climatic zone in Uttar Pradesh has been suggested on the bases of rainfall pattern, temperature, soil type, availability of irrigation water, and existing cropping pattern (Saxena, 1989). According to this state-wise classification, Hardoi comes under Central Plain Zone. The major ecological problems as identified by this Survey in this Central Plain Zone are: (i) rising water table/impeded drainage; (ii) salinity and alkalinity of soil; (iii) low fertilizer use efficiency; and (iv) non-availability of suitable varieties, and techniques for drought prone area for utilisation of available soil moisture.

The core of strategy suggested to overcome constraints in Central Plain Zone is a massive land and water resource

development, optimal crop mix for increased water use efficiency and diversified agriculture (Trivedi, 1989). It is suggested that effective employment generation plans will have to be related to issues of land and water development, crop planning and improvement of farm productivity. The potential to develop horticulture and sericulture exists. This, however, needs the support of marketing, storage, and processing facilities.

The village level, ecological realities are, however, much more dismal than shown in expert's reports. One can see vast patches of white, dusty soil in agricultural fields and on the sides of walkways. There are scarcely any forest or groves which provide adequate income to the owners.. Even on the sides of the brick-road that connects Gaju to Kachauna and Balamau, plantations of trees was not visible. The trees that have been planted on village common land under the social forestry scheme, have either dried or in a poor shape. Near the inhabited areas of hamlets, however, traditional varieties of trees like, Neem, Jamun, Aam, Peepal, Bargad, Kathal and Mahua were seen. No exclusive grazing lands were found in hamlets of the cluster. The village common land that is earmarked for grazing did not appear to have sufficient grass for fodder. The ponds were either dry or had very little water because of the summer season. They are used to conserve rain water to be used for irrigation and household work. There are few private wells in the cluster for drinking water in addition to the hand-pumps fixed under safe-drinking water scheme.

It was, thus, clear during the first week of our visits that there was virtually no integrity in the 'agro-sylvo-pastoral' system of the village cluster. There were inter-settlement differences with regards to the use of ecological resources which indicated that perhaps villagers had their own reasons to do so.

When we asked our key informant, the Gram Vikas Adhikari, about these differences in resource use, he tried to explain them in terms of villagers' occupational preferences. But it was latter revealed by villagers during the course of group discussions that reasons are more ecological than social or economic. They, however, felt that their knowledge of local ecological conditions are never taken into account in development schemes of the government. There is no action framework available for village ecosystem planning. The men, women and children who were enthusiastically taking part in group discussion, seemed to be aware of the fact that their settlement was a complex land-livestock-vegetation system. They could identify the ecological factors causing the present imbalances in the village ecosystem. These are:

(i) Uncertain rains;

(ii) Expanding wasteland (Usar) during last 20-25 years and declining soil strength;

(iii) Water logging in fields at the time of heavy rains;

(iv) Unsuitability of canal irrigation ;

(v) Scarcity of fuelwood and use of cowdung cakes as fuel;

(vi) No suitable grasslands for fodder;

(vii) Silting of tanks and clogged water channels;

(viii) Common property like grasslands, tanks and ponds are not maintained properly;

(ix) Grazing of tree leaf on the common land, thus affecting regeneration of trees; and

(x) Increasing use of chemical fertilizers and high-yielding varieties of seeds make the cropping costly and risky affair.

It was clear during the participatory appraisal of ecological situation that people were alarmed about the situations prevailing in their hamlets. They, however, feel helpless and fail to come out with any viable solutions. Time and again, they were heard saying that government should do something for them. They have no forum where they can put their views on the problems encountered by them. The sense of dependence developed by the villagers reflect the enormous control that government machinery has over their lives. Their survival instinct helps them maintain a subsistence level in an ecologically degraded social system. In addition to their involvement in cultivation of cropland, most households are involved in animal husbandry. A few other households belonging to lower castes were found involved in sheep-rearing and piggery in additions to wage earning.

Finally, we found that no conscious effort has been made by cluster population to protect their degraded ecology despite the awareness of the letter.

3.5 Summary

In this chapter, the socio-economic and ecological profiles of the village cluster are depicted. It is argued that the interplay of several culture-specific and local ecology-dependent factors give shape to the village SES. The interplay of these factors leads to complex processes of change and stagnation in the village cluster. The dynamics of these systemic processes is examined in the next chapter.

CHAPTER 4

EXISTING DEVELOPMENT SCENE AND DYNAMICS OF IMPOVERISHMENT IN THE VILLAGE CLUSTER

4.1 Introduction

The development and impoverishment both may exist as change processes in the socio-ecological system profiled in the preceding chapter. While development is usually a process of induced change, impoverishment results from the failure and/or unsustainability of the former. This chapter deals with the examination and analysis of these processes in the village cluster under study.

Section 4.2 provides a critical appraisal of existing development programmes in the light of their relevance and suitability to activity areas, and performance objectives for sustainable rural development. The responses of villagers, as well as, social actors involved in development delivery apparatus, provide the bases of this critical appraisal. The analysis of problems of development in the cluster is supplemented in section 4.3 by a social cybernetic analysis of village impoverishment. The latter involves the construction of a multi-feedback loop model representing dynamics of impoverishment and identification of salient variables of the same. The salient variables are like 'emergent properties' of system dynamics and synoptically show the complex systemic interactions and their consequences. Section 4.4, the last one, summarises analysis of development problems and dynamics of

impoverishment in the village cluster. In addition, the role of development planning in the present context is briefly discussed.

4.2 Status of Existing Rural Development Programmes in the Village Cluster

It appears from the socio-economic and ecological profiles of the village cluster that deprivation and impoverishment persists in both socio-sphere and eco-sphere of the village. The problems like, factionalism, gradual knowledge-loss, imbalances in resource ownership, faulty resource-use, unfulfilled basic needs, etc., have negatively affected villagers' capacity to adequately respond to the persisting crisis. Their adaptability to changing socio-ecological conditions seems to have declined. Most villagers opined that their capability to improve quality of life is now less as compared to say, twenty years back. Though, there is differential intensity of deprivation and impoverishment among social groups, the nature of responses they give to questions regarding development problems, are more or less similar. It is apparent from their responses that the feeling of vulnerability is all pervasive in the cluster. Since, enormous ecological degradation has taken place in the recent past the life in the cluster is not as easy as it used to be. While people above fifty years of age feel more dependent upon government assistance, the younger ones look for additional sources of income. As a result, young working population migrate to near-by cities. Thus, occupational diversification is more visible than

desired changes in the overall socio-ecological conditions in the hamlets.

The development programmes initiated by the government overlook the village level realities. Moreover, there is no synergy in various schemes that have been sanctioned for the village since the inception of development planning. It was apparent that development programmes in previous years were not successful as participants in group discussions could not recollect any programme that really helped them cope with the then problems. When they were persistently asked about the reasons for such a feeling, some of them gave the example of the programme of agriculture development initiated by the government in late 1960s. This involved construction of a network of small canals in command area, distribution of high yielding varieties of seeds, chemical fertilizer, etc. Most villagers involved in agriculture now feel that these measures have made agriculture a very costly affair. Their need for cash money has increased because of costly inputs. However, the equally matching returns often elude them.

A section of the village population involved in animal husbandry places themselves as better off. The agriculture for them is a source of fodder for cattle. It is through their individual efforts that they have developed husbandry as good source of income.

The group discussions with landless labourers and disadvantaged caste people revealed that credit provided under Integrated Rural Development Programme (IRDP) has met their financial needs temporarily. It has failed to provide them a productive and permanent source of income and employment. They hope that government would waive the loans because they are poor. The land allotted to some of the landless families is very small in size, and mostly wasteland (usar). These plots of land remain fallow and are hardly used for cultivation. Under the Wasteland Reclamation Scheme initiated in 1989-90, 18 villagers were selected as beneficiaries. When some of them were approached, they opined that scheme is going to be a failure as constant technological and financial support is required to reclaim wasteland for productive agriculture.

A listing of all currently operative development programmes in given in Table 4.1

Each programme has objectives that address to specific needs of different segments of the village population. The focus of JRY, for example, is on creating wage employment for agricultural labourers during the lean period rather than on the synergistic potential of the kind of works undertaken. Wasteland Reclamation Scheme is very much needed but lacks constant support and local participation. The beneficiaries selected under this scheme are

Table 4.1

Currently Operative Development Programmes in the Village Cluster

Sl.No.	Development Programmes
1.	Jawahar Rojgar Yojana (JRY)
	a. Repair of Link Roads
	b. Brick Road Construction
	c. Repair of Wells
	d. Cleaning of Water Courses
	e. Digging and Cleaning of Ponds
	f. Repair of School and Community Centre
	g. Social Forestry
2.	Wasteland Reclamation Scheme
	a. Subsidy for Bore Wells
	b. Credit for Pump Sets
	c. Bunding of Wasteland Plots
	d. Construction of Drains
	e. Making available soil supplements.
3.	Setting up of Hand Pumps for Drinking Water
4.	Poor Men's Housing
5.	Setting up Biogas Plants
6.	IRDP for poor
7.	Subsidized provision for seeds, fertilisers, implements, pesticides, animal feed & veterinary care.

Note: These programmes were implemented during 1990-91. Except the Waste Land Reclamation Schemes, all other programmes are still operative as per the records available at Block Development Office, Kachauna.

skeptical about the advantages promised under the scheme. The Integrated Rural Development Programme (IRDP) aims at creating permanent assets as source of income for those who are below poverty line. The subsidies and credit provided under the scheme

are, however, used in activities that lack long-term feasibility. The other programmes like, hand pumps, housing for the poor, biogas, provision of inputs, are need-based but suffer from adhocism and inefficiency in implementation.

A very paradoxical picture emerged about the status of government development schemes during the group discussions with villagers. Most of them are apathetic to government schemes and yet, want the government (Sarkar) to do more and more. It was noticed that all sections of the cluster population are very much aware of different schemes planned by the government for their welfare. The potential gains are assessed by them in terms of the increased capability to improve their living standard vis-a-vis others in the village. The good living standard means a secure, and harmonious existence in their surroundings. The development assistance has, however, increased the feelings of jealousy and competition which in turn has intensified the polarisation and factionalism.

The villagers' awareness about government programmes was more apparent when they were asked to relate these programmes to various activity areas for sustainable rural development. Table 4.2, summarises their responses and comments on the relation of currently undertaken programmes to activities required for sustainable rural development. It is clear that most activity areas remain untouched by the government sponsored rural development in the cluster.

Table 4.2

Classification of Governments' Development Programmes in terms of the Activity Areas for Sustainable Rural Development

.No.	Activity Areas for Sustainable Rural Development	Existing Development work undertaken by the Govt.	Remarks
.	Natural Resource Development		
(i)	Afforestation	Social Forestry on Village common land	Major aim employment and income generation. Unsuccessful
ii)	Irrigation	Subsidised boring and credit for Motorised pump	Partially Successful
iii)	Grassland	X	X
iv)	Soil Conservation	Wasteland (Usar) Reclamation scheme	Unsuccessful
v)	Watershed development	Digging and cleaning of ponds	Aim is to create employment and income. Provides wage labour
.	Rural Infrastructure Development		
(i)	Transportation	X	X
ii)	Roads	Brick roads and link roads	Need constant repair
iii)	Energy	Setting up Biogas plants for households	Unsuccessful
(iv)	Drinking Water Supply	Setting up Hand Pumps	Very successful
v)	Communication	X	X

Table contd..

Human Resource Development		
(i) Health and Nutrition	Mother & Child care centre	Unsuccessful
ii) Education	Primary School	Partially successful
iii) Family Planning	Sterilization	Partially successful
(iv) Shelter	Poor men's Housing scheme	Unsuitable to rural environment
. Agriculture Development		
(i) Input Activities related to Agricultural Development		
(a) Seeds, fertilizers, implements, pesticides, animal feeds, veterinary care	Available at Block Office and Veterinary Hospital.	Delayed and Inadequate supply; cumbersome process of acquiring
(b) Credit	Cooperative Bank, Rural Bank, Commercial Bank	Unsuccessful
(c) Technological inputs like know how and techniques	X	X
(ii) Throughput Activities		
(a) Agricultural crops	X	X
(b) Husbandry	X	X
(c) Horticulture	X	X
iii) Output Activities		
(a) Storage	X	X
(b) Transportation	X	X
(c) Marketing	Cooperative Society (Mandi Samiti)	Unsuccessful

Table cont...

. Rural Industries Development		
(i) Processing Units (for fruits, oilseeds)	X	X
(ii) Manufacturing from local raw material	X	X
(iii) Marketing of manufactured items	X	X

The participants in group discussions could also evaluate the above development programmes in terms of their suitability for achieving the goals of sustainable rural development in the cluster.

Table 4.3 gives an overall picture of our observations regarding this aspect of development programmes. It is clear from the table that most development programmes operative in the cluster are oriented towards generating employment and income. In the process, other objectives are neglected and therefore development is not sustainable. The perceived benefits from some schemes are not fully realized. In fact, the benefits are often appropriated by the powerful and dominant sections of the village. Therefore, the young people belonging to the poor sections are apprehensive about the secure life in the village. It is their attachment to family that compels them to be in the village or make visits if they have migrated to cities.

Table 4.3

Suitability of Government's Development Programmes to Goals of Sustainable Rural Development.

Sl. No.	Name of Programmes	Goals of Sustainable Rural Development				
		EIG	PRI	BNS	SYP	SRU
1.	Social Forestry	_/	X	X	X	_/
2.	Subsidy and Credit for Borewell & Handpumps	_/	_/	_/	X	X
3.	Wasteland Reclamation	_/	X	X	X	_/
4.	Digging & Cleaning of Ponds	_/	X	_/	X	_/
5.	Link Road Construction	_/	_/	_/	_/	X
6.	Bio-gas Plants	X	X	X	X	X
7.	Hand Pumps	_/	X	_/	X	X
8.	Mother & Child care centre	X	X	_/	X	X
9.	Primary Education	X	X	_/	X	X
10.	Sterilization & distribution of contraceptives	X	X	X	X	X
11.	Poor Men's Housing	_/	X	_/	X	X
12.	IRDP	_/	X	X	X	X

NOTE : EGI = Employment and Income Generation;
BNS = Basic Need Satisfaction;
PRI = Productivity Improvement;
SYP = Synergistic Production; and
SRU = Sustainability of Resource Use.

The village people could not, however, articulate their responses to viability of development programmes. But it was clear that they found most development programmes as

culturally and ecologically incongruous. For deeper understanding of the practical failure of development programmes, guided interviews were conducted with top, middle, and lower level development functionaries, peoples' representatives in local government institutions, experts in specialised departments, and workers in a local voluntary organization. Though respondents did not have well articulated views, their perceptions about the poor performance of development programmes, as reported during the course of interviews, are listed below:

(i) Erosion of local resources;

(ii) Small land holdings;

(iii) Inputs are not available in time;

(iv) Inputs are costly;

(v) Very little scope for cash crops;

(vi) Natural disaster in the form of droughts;

(vii) Plant diseases;

viii) Bio-gas does not succeed because less per capita cattle;

(ix) Technical demonstrations of new products and procedures unsuccessful;

(x) Gap between planning ideals and practice;

(xi) Storage facility defective and inadequate;

(xii) Development functionaries at the middle (Block) and lower (Gram sabha) level demoralized;

xiii) Factionalism at the panchayat level;

(xiv) Panchayat Raj institutions are not functioning because of official interference;

(xv) Lack of personal interest among panchayat officials in development activities;

(xvi) Poor infrastructure at the village level;

xvii) Political consciousness in the village without social responsibility;

viii) Centralized policy formulation and decision making is not successful;

(xix) Primary education is a failure at the village level;

(xx) Programme evaluation does not include affected people;

(xxi) Corruption in government departments and panchayat bodies;

xxii) Sectoral needs for technical know-how are not fulfilled;

xiii) Cooperative societies are controlled by powerful and corrupt people;

xxiv) Public Distribution System inefficient;

(xxv) No weather forecasts;

xxvi) In the case of crop failure, no security to the villagers;

xvii) Indebtedness of farmers because of insecurity and risks in the farming;

xviii) No awareness of alternative productive activities suited to the area;

xxix) Absence of local leadership;

(xxx) Voluntary organization is basically a one man show;

xxxi) Bank credit is not useful in the absence of technological support;

xxii) Subsidy is diverted to other uses;

xxiii) Identification of beneficiaries is false as the land records are not available at that moment;

xxiv) No proper utilisation of village common property because of factionalism;

xxxv) Rigid government procedures;

xxvi) No autonomy to villagers as far as the implementation of development programmes is concerned;

xxxvii) No internally generated desire for development;

xxxviii) Absentee landlordism/share-cropping;

(xxxix) Supporting employment oriented activities not available at the village;

(xxxx) Lack of marketing infrastructure;

(xxxxi) No experimentation for development of location specific technological inputs;

xxxxii) Complex technology. No simplification attempted;

xxxxiii) Capacity to repay loans is not developed;

xxxxiv) No focus on productivity improvement in a sustained way; and

(xxxxv) Organisational structure of development administration defective and gets manifested into uncoordinated development programmes.

It is clear from the above observations that realities of rural development activities are quite complex to fathom. The interplay of social, cultural, economic, ecological and administrative factors present a very complicated picture of village social life. The development programmes that government has initiated fail in most cases probably because this complex interplay of factors is never taken into account. This complexity can be understood in the form of a particularised representation of impoverishment in the village cluster. This is the basic requirement for further policy analysis leading to explanation, prediction, evaluation, and monitoring of the problem situation.

4.3 Dynamics of Impoverishment in the Village Cluster

The failure of development process and persistence of a complex set of direct and indirect problems clearly indicate the continued impoverishment in the socio-sphere as well as in the eco-sphere of the village cluster. While it may be difficult to provide deterministic explanations about nature and dynamics of impoverishment, a pattern can be discerned for purposes of planning and policy analysis. The latter has been achieved here through cybernetic methodology of multi-feedback loops, representing cyclical patterns of information flow among multiple factors constituting the system.

4.3.1. Cybernetic Methodology for Policy Analysis

The cybernetic methodology for policy analysis and problem-solving is based on the analytic constructs of negative, and positive, feedback cycles; the regulatory role, and malfunctioning of the cyclic processes; and the dynamically complex multi-cycle structure (Rastogi, 1992). Its underlying premises may be briefly stated as follows:

1. The inherent dynamic nature of social reality is captured by circular reactive processes shown as feedback cycles having intended regulatory roles.

2. The fundamental mechanisms of stability and change, are encapsulated by the negative and positive cyclical mechanisms respectively.

3. The vital distinction between a normal phenomenon, and a problem situation, is normally broughtout through the concept of malfunctioning cycles.

4. The diversity and variety of phenomena, even within a single class of social situations, is symbolically

representable and accounted for, by differential operations of feedback processes.

5. Systemic interactions and processes are highly non-linear and inter dependent. They cannot be cognised and depicted in terms of linear, unidirectional causation.

6. A multi-loop structure comprising several feedback cycles, constitutes an integrated theoretical model of a phenomena/problem. It is a synoptic replication of the dynamic aspects, factors and features of real world social situations, in terms of their multilateral relationships of stability and change.

7. A multi-loop structure conjoins together all the valid knowledge about a phenomenon. Its knowledge base draws from the multi-disciplinary sources of information and evidence. The model dynamically interrelates them together in order to bring out the nature, characteristics, and complexity of an investigated phenomenon.

8. The model may be constructed showing a generalised theory for a class of social phenomena/problem, as well as the dynamic theoretical representation of a specific empirical situation with its unique characteristics.

   In the present context, the methodology is used for particularised representation of impoverishment in a village cluster.

9. Explanation, prediction and requirements of problem-solving are provided together in a unified manner by a multi-cycle structure. The salient variables which represent the foci of systemic interactions provide the vantage point for policy analysis. A number of other useful inferences are also systematically derivable from this structure.

The multi-loop model of the village impoverishment is constructed and elaborated in the following section.

4.3.2 The Multi-loop Model of Impoverishment

In a micro-level study of rural poverty in a village cluster of Uttar Pradesh, Rastogi (1986) demonstrated that dynamics of underdevelopment and poverty is related to three salient factors. These are: programmes of development;

inefficiency and subversion of operative programmes; and factors related to indebtedness, exploitation and suppression of rural poor by dominant castes. In the present study, however, field experiences show that impoverishment as a process is much more complex in nature. It became evident during field visits, group discussions, and interviews that failure of development process and persistence of impoverishment are related to several social and ecological factors. The recurrent set of factors were recorded and inter-connectedness among them was later worked out in the form of feedback cycles.

A listing of cluster-specific variables is given below:

1. Factionalism and social tensions.
2. Lack of organisational potential.
3. Poor articulation of development needs.
4. Poor communication with government functionaries.
5. Dependence on government machinery.
6. Panchayat controlled by dominant factions.
7. Faulty planning and implementation of government's development schemes.
8. Clogged canals and water courses.
9. Failure of credit schemes.
10. Failure of non-conventional energy development schemes.
11. Inadequate potable water facilities.
12. Poor educational facilities.
13. Absence of basic health care facilities.
14. Non-availability of technical know-how for resource use.

15. Poor infrastructural facilities.
16. Poor working of cooperative societies.
17. Failure of wasteland reclamation scheme.
18. Failure of social forestry scheme.
19. Poor quality of life.
20. Low agricultural productivity.
21. Non-availability of soil testing facilities.
22. Impoverishment and deprivation.
23. Low household income.
24. Unemployment and underemployment.
25. Inadequate investible capital.
26. Few income earning opportunities.
27. Migration to urban area.
28. Neglect of agricultural operations.
29. Deforestation.
30. Low productivity of animal husbandry/sheep rearing/piggery.
31. Inability to utilize ground water resources.
32. Lack of assured irrigation.
33. Drought proneness of the area.
34. Prevalence of single cropping.
35. Frequent crop failure.
36. Unproductive resource use.
37. Lack of fodder.
38. Low productivity of horticulture.
39. Inadequate soil treatment.
40. Soil alkalinity.
41. Large areas of wasteland.

42. Reduced area for cultivation.

43. Historical and political factors (exogenous)

44. Corruption and inefficiency in government department (exogenous).

45. Widespread social and economic inequality (exogenous).

46. Poor watershed management in Central Plain Zone of Uttar Pradesh (exogenous).

The above list of variables is free from the defect of redundancy and shows the complex set of factors involved in the dynamics of socio-ecological impoverishment in the village cluster. The qualitative significance of these variables is self-explanatory and empirically verifiable. When organised into interrelated sets of propositions, these variables constitute the problem's knowledge base, represented by feedback loops. Each loop shows the empirically observed malfunctioning in the system.

The explication of some of these feedback loops is as follows:

(a) What leads to the villagers' dependence on government machinery for development?

Dependence on government machinery continues because villagers' fail to organize themselves for collaborative actions for development. This proposition constitutes a positive feedback cycle as shown in Figure 4.1.

The intended regulatory role of this feedback cycle is to bring about continuous decline in the villagers' tendency to dependent on government machinery for meeting developmental needs

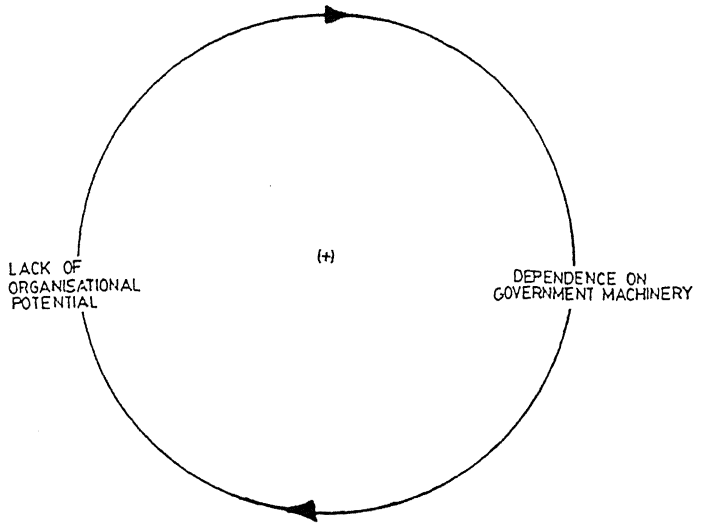


FIG.4.1 VILLAGERS' DEPENDENCE ON GOVERNMENT MACHINERY

through inter-group organisational efforts. The actual operation of the constituting variables, however, results in the continued malfunctioning of the loop. The malfunctioning is evidenced by the fact that total absence of local organisational initiatives for sustainable development has caused increasing dependence of village population on government departments which are hierarchically structured and function according to the 'top-down' approach, in the process neglecting local requirements. Since operation of the loop is affected by other system variables viz., Factionalism and Social Tensions; and Impoverishment and Deprivation - the malfunctioning of the loop becomes more complex.

(b) What perpetuates the faulty planning and implementation of government's development schemes?

Lack of organisational potential causes poor articulation of development needs. The latter results into poor communication with government functionaries which, in turn, leads to the failure

to incorporate indigenous knowledge and felt needs in the planning and implementation of development schemes by government departments and agencies. One of the several consequences of faulty planning and implementationis the poor education facilities in the village cluster, which causes poor quality of life in the households. The latter contributes to the continuation of impoverishment and deprivation among most households who are resource poor. This increases poor's dependence on government machinery which continues due to the lack of organizational potential. The poor articulation of development needs, poor communication with government functionaries, and finally faulty planning and implementation of government's development schemes sequentially follow from lack of organisational potential among villagers.

The above propositions constitute a positive feedback cycle connecting together eight variables as is illustred in Fig. 4.2.

The cyclical flows between the interconnected variables shows the apparent malfunctioning in the mode of loop operation. The desired/intended mode of loop operation is improvement in educational facilities, better quality of life, reduction in impoverishment and deprivation, reduced dependence on government departments, local organising for 'self-help' activities, clear articulation of development needs, effective communication with government functionaries, and finally improvement in the planning and implementation of government sponsored development schemes.

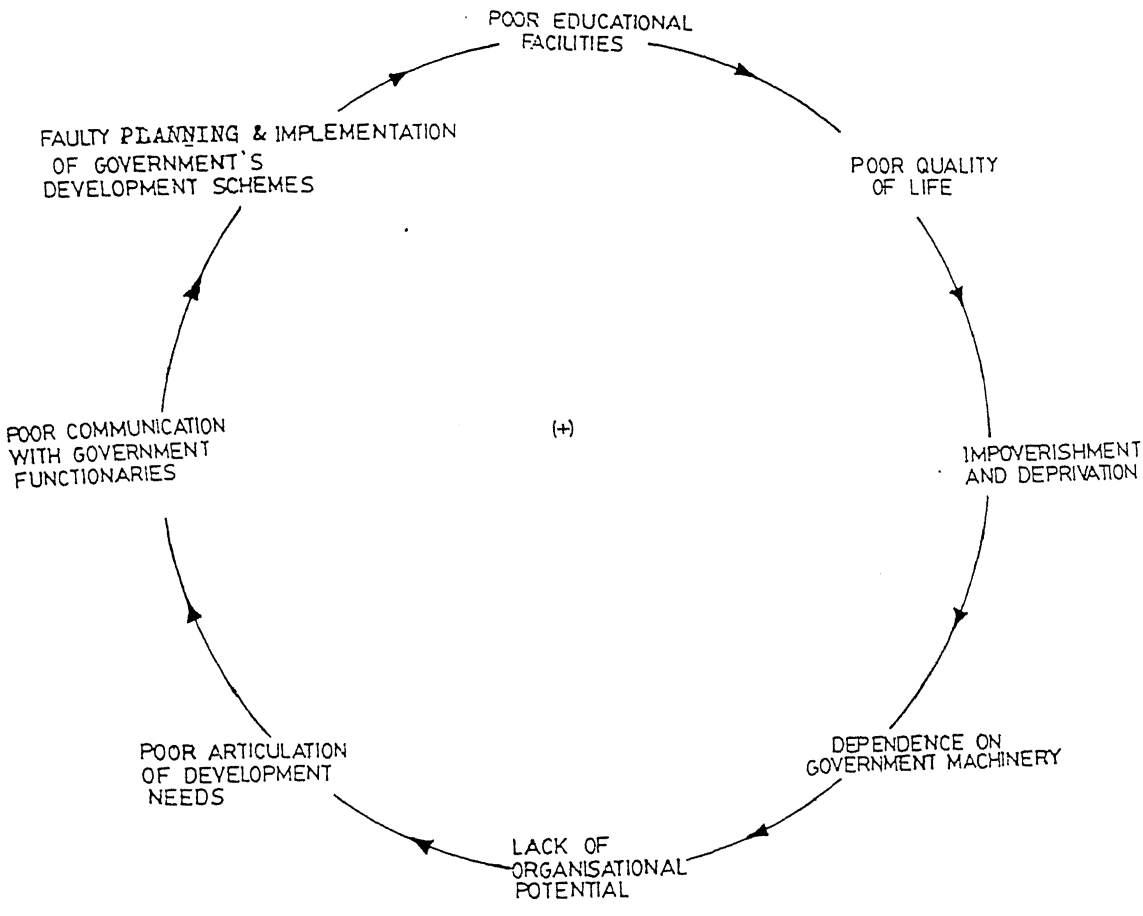


FIG.4.2 PERPETUATION OF FAULTY PLANNING AND IMPLEMENTATION OF GOVERNMENTS' DEVELOPMENT SCHEMES

The intended regulatory role of this feedback cycle is, however, not achieved in the village due to malfunctioning which is further complicated by the mutual operation of other feedback cycles.

(c) What causes continuous impoverishment and deprivation of poor households in the village cluster?

The initial inadequacy of investible capital in poor peasants' families causes their inability to use ground water resources through efficient means, for agricultural purposes. The visible lack of assured irrigation gives rise to the situation of rain-fed farming in the village cluster which, in turn, renders the area drought prone. The drought pronness leads to frequent crop failure. The sudden scarcity of crop residue results into lack of fodder which gives rise to over-grazing of trees and other locally available flora. The resulting deforestation (which is also caused by demand for fuel wood) contributes to the creation of wastelands in the village cluster. The unreclaimed wastelands contribute to the shrinking land availability for agriculture which reduces the productivity potential of agricultural production. The low agricultural yields are the major factor for low household incomes which causes the continuation of impoverishment and deprivation in poor households and inadequate investible capital availabe to them.

The above propositions constitute a positive feedback cycle connecting together twelve cluster-specific variables. Figure 4.3 illustrates this cycle's mode of operation.

The malfunctioning in the loop operation is evident by the fact that certain cluster specific ecological problems get aggravated by low household incomes which further aggravate the latter through deforestation, wastelands, and low agricutural

producitivity.

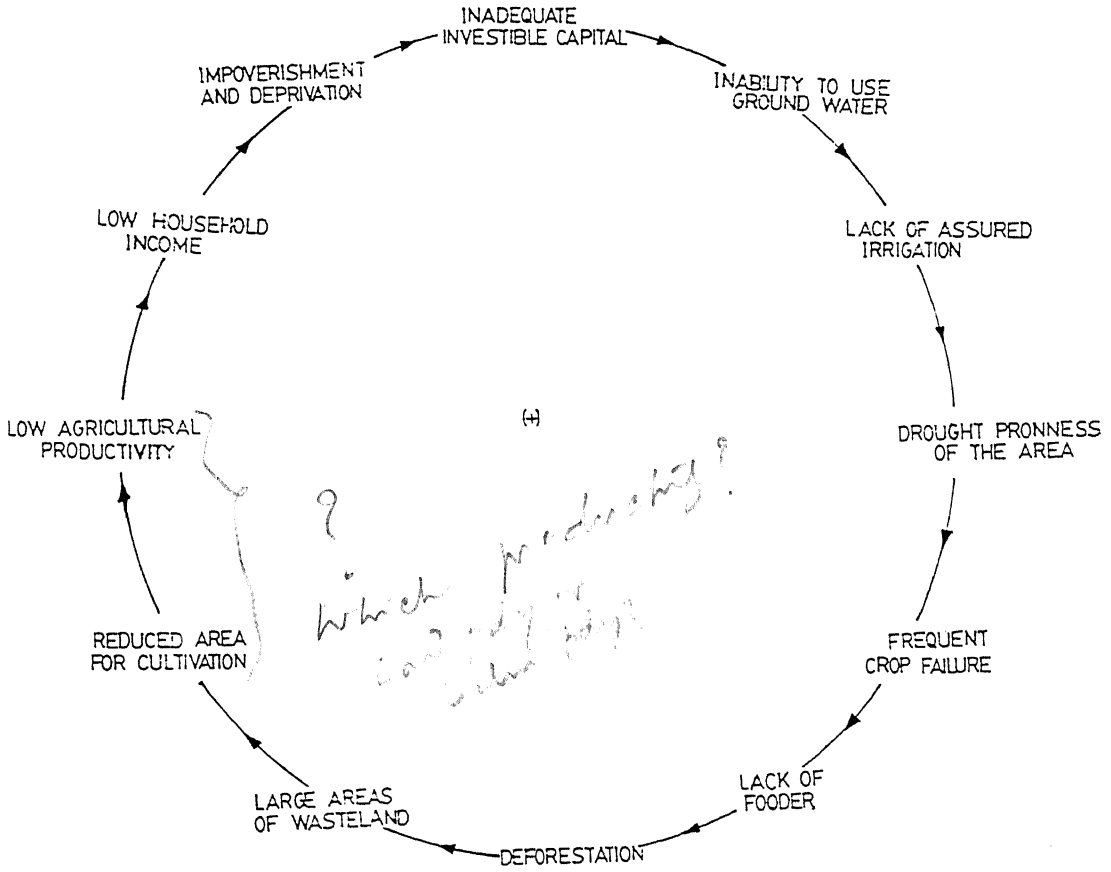


FIG.4.3 IMPOVERISHMENT AND DEPRIVATION AMONG POOR HOUSEHOLDS

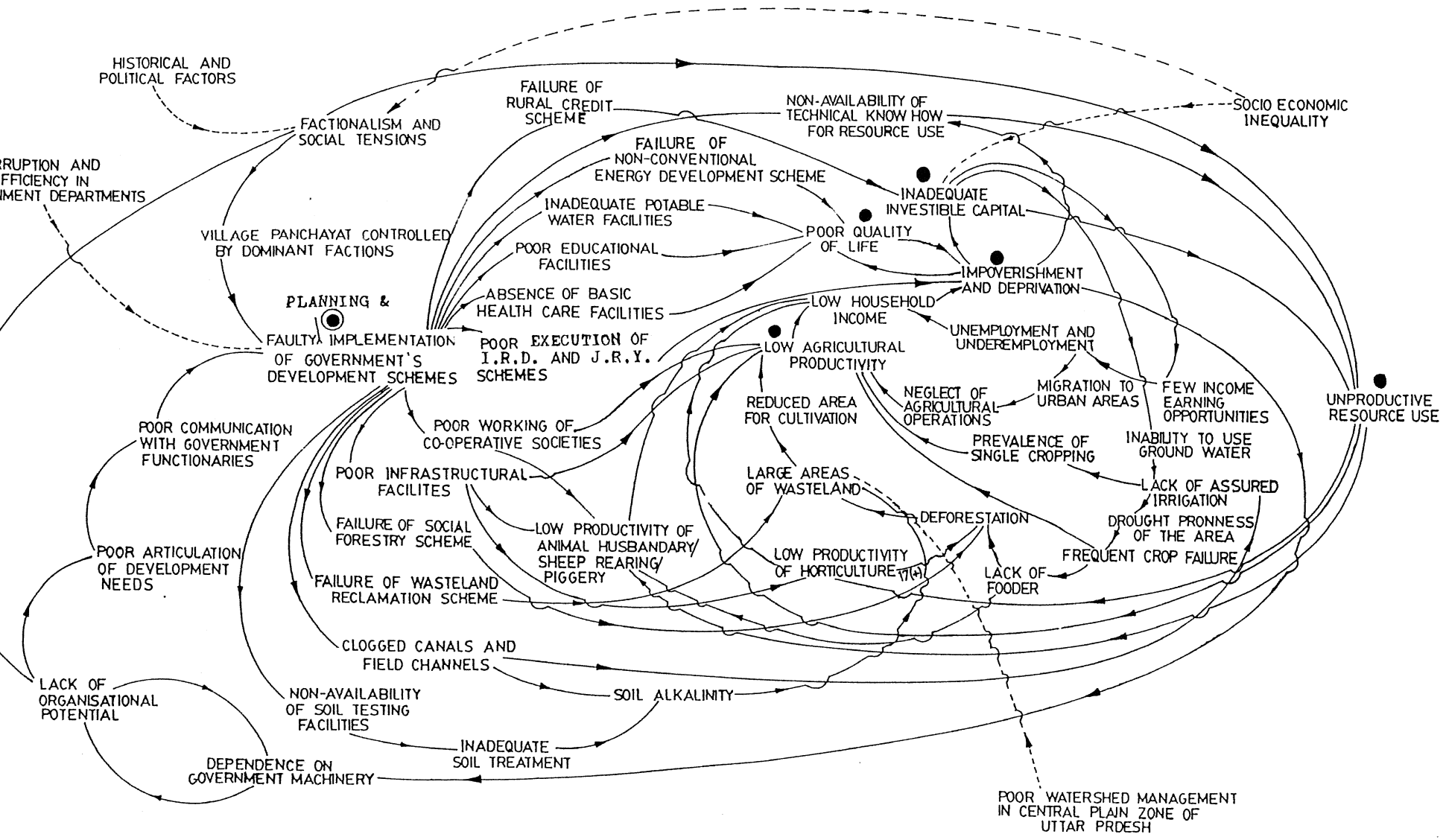
The brief exposition of a few feedback loops of the system model shows the mode of loop operations and resulting malfunctioning as empirically seen in the village cluster.

The aim, however, is to discern the pattern of impoverishment in a holistic manner. The multi-feedback loop model constructed from several feedback cycles represent the village impoverishment in its totality .

The multi-feedback loop model of village impoverishment constructed from empirically observed interconnectedness among variables identified, and propositions deduced, is shown in Figure 4.4. The model describes and explations the nature and dynamics of impoverishment in the village cluster in a holistic manner. There are forty six variables in the model out of which four are exogenous in nature. Their empirical significance in accounting for the dynamics of impoverishment is contexual and cluster specific. They are aggregated to keep the representation of complex impoverishment process at the manageable level.

The model depicts cyclical relationships among these variables in the form of feedback loops. All the loops are of positive feedback type indicating the persistence of impoverishment process in the system. In other words, the absence of appropriate deviation restraining influences in the system lead to the failure of development process initiated in the village.

The multi-loop systemic analysis provides the understanding and explation of internal system dynamics in a synoptic manner. This also helps the policy analyst to draw certain diagnostic and predictive inferences about health of the system. The identification of salient variables of the complex problem



● SALIENT VARIABLES
--- EXOGENOUS VARIABLES
◉ CHANGE LEVER VARIABLE

FIG.4.4 DYNAMICS OF IMPOVERISHMENT IN GAJU

situation represented by several feedback cycles provides the basis for explanation, prediction, and problem solving in a synoptic manner.

4.3.3 Salient Variables of Impoverishment

Each variable in the multi-loop structure receives and emits a number of links to other variables. The number of links emitted by a variables, i.e., the number of variables affected by a variable, defines its relative control position in the system dynamics. Similarly, the number of links received by a variable, i.e., the number of variables affecting the variable, defines its relative constraint position in the system. Total number of links, i.e., incoming and outgoing, associated with a variable, defines its relative centrality and importance in the system. Variables with relatively grater number of links are accordingly the most salient. They stand at the intersection of several cycles and their changing states represent the cumulative outcome of the multi-lateral interaction processes in those cycles. To use the Systems Approach terminology, salient variables represent the 'emergent properties' of the system dynamics.

The dynamics of impoverishment in the village cluster, shown in Figure 4.4, may be synoptically explained in terms of six salient variables identified on the basis of sum of input and output links of the variable. The salient variables of impoverishment process in the village cluster are shown in Table 4.4.

Table 4.4

Salient Variables (SVs) for the Problem of Impoverishment in the Village Cluster.

Sl. No.	Salient Variable (SV)
1.	Faulty Planning & Implementation of Government's Development Schemes
2.	Low Agricultural Productivity
3.	Poor Quality of Life
4.	Impoverishment and Deprivation
5.	Inadequate Investible Capital
6.	Unproductive Resource use

These six salient variables represent the foci of internal system interactions and exogenous influences responsible for the persisting malfunctioning in the system. A brief description of each salient variable will explain the persistence of impoverishment in the village cluster more cogently. Also, the qualitative assessment of each salient variable in terms of its actual and desired role in meeting five goals of sustainable development* in the system, would define seriousness of the problem situation.

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* Five performance objectives for sustainable development process are mentioned earlier in this chapter. These are (i) Employment and Income Generation (EIG); (ii) Productivity Improvement (PRI); (iii) Basic Needs Satisfaction (BNS); (iv) Synergistic Production (SYP); and (v) Sustainable Resource Use (SRU).

1. **Salient Variable : Faulty Planning & Implementation of Government's Development Schemes**

This variable refers to the failure of development schemes initiated by the government to check impoverishment process in the village cluster. The desired state of development intervention would have been such that all five performance objectives are achieved in an integrated manner. On the contrary, it was observed that most programmes failed to even address these objectives at the implementation level. It appears that problematic nature of this variable is largely caused by factors related to programme management. The latter refers to organisational factors like delivery of services; type of interaction between organisational actors and beneficiaries; and decision making factors like, use of management tools and general approach to planned change.*

2. **Salient Variable : Low Agricultural Productivity**

This variable refers to relatively low yields from agricultural operations than are actually possible. The desired level of agricultural productivity would have led to a near employment situation and higher incomes. Moreover, this would have led to expansion of other existing activities like, animal husbandry, sheep rearing, and piggery; expansion of production

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* Blankenberg (1991) has also observed that poor programme management leads to failure of technological interventions in Indian rural society.

synergies in the form of agro-industries, and dairy development, etc. The increase in income levels would have satisfied the felt needs of village people. In reality, however, none of these seems to be happening in the village cluster. Rather, it is observed that agricultural operations are unsustainable, and small and marginal farmers express their unwillingness to pursue agriculture as full-fledged profession.

3.Silent Variable : Poor Quality of Life

This variable refers to poor nutritional status, public health facilities and literacy standards in the village cluster. In addition, the unhealthy sources of domestic energy also causes poor health. The combined impacts of these negatively affect all performance objectives of sustainable development. Females and children of the cluster appeared to be the worst affected because of their poor accessibility of means to satisfy basic needs. This indicates the prevalence of deprivation which further perpetuates the poor quality of life.

4. Salient Variable : Impoverishment and Deprivation

This variable refers to the conditions of extreme deprivation and socio-ecological impoverishment faced by the landless section of the village cluster. These villagers are painfully aware of the fact that they are a deprived lot as compared to people who own land. When asked to elaborate their views, a few articulate ones noted that lack of income earning opportunities, meager household incomes, and failure to get health

care and clean drinking water, are clear indication that life for them in the village is not very easy.

5. **Silent Variable : Inadequate Investible Capital**

Lack of credit facilities and investible surplus causes stagnation in the growth of existing production activities in the village. This leads to underemployment, low incomes, low productivity and unfulfilled basic needs. Moreover, chances of starting supportive production activities remain meager.

6.**Salient variable: Unproductive Resource Use**

The existing resource use pattern in the village is not only unproductive but also ecologically unsustainable. For example, small and marginal farmers are involved in subsistence agriculture as they find use of presently available inputs beyond their reach. Similarly, most commonly owned resources like, village ponds, field channels for canal irrigation, pasture land, etc., remain unused and there are clear indications that over the years they are degraded to an extent that their productive use is not possible without constant technological and financial support. The tree plantation on common lands remains unprotected, and is open to grazing.

It is apparent from brief description of salient variables, and qualitative assessment of their actual and desired roles in achieving performance objectives of sustainable development, that problem of impoverishment in the village

cluster is of serious nature. Impoverishment is persisting because all salient variables are functioning at a 'low' pace. It may be, therefore, concluded that efforts of planned change in the village have substantially failed. The problem becomes more serious because of the fact that appropriate solution measures and control policies are not formulated at the government level, and at the level of villagers themselves.

4.3.4 Constraint, Control and Change-Lever Variables of Impoverishment

Though identification of salient variables in the multi-feedback loop model, provides the synoptic picture of impoverishment problem, a few more inferences may be drawn for diagnostic purposes.

1. Constraints in the system dynamics are represented by such variables which get affected by greater number of variables. In other words, there are more input links in these variables (Rastogi, 1992). Table 4.5 shows the list of such constraint variables in the system model.

It is evident from table 4.5 that, Low agricultural productivity; Poor quality of life; Low productivity of occupations like animal husbandry, sheep rearing, and piggery; Low household incomes; and Large areas of wasteland are the significant constraints in the system. They resist the self organising efforts of the system towards healthy dynamic equilibrium.

Table 4.5

Constraint Variables in Multi-Feedback Loop Model of Impoverishment

Sl. No.	Variable
1.	Low Agricultural Productivity
2.	Poor Quality of Life
3.	Low Productivity of Animal husbandry/ Sheep rearing/Piggery
4.	Low Household Income
5.	Large Areas of Wasteland

It is pertinent to note here that out of five constraint variables, two are salient variables of the system. It may be argued that these two represent important nodal points in internal system interactions. Their identification as constraint variables along with three other provides an additional diagnostic inference relevant for problem analysis. The constraint status of all variables shown in Table 4.5 simply draws analyst's attention towards factors influencing 'vulnerability', 'resilience' and 'capacity of response'* properties of the socio-ecological system of the village.

2. Control variables in the system are those which affect more variables as compared to the number of variables affecting them.

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* These systemic properties are suggested by Gallopin et. al. (1989) and are elaborated in chapter 2.

In other words, there are greater number of output links emanating from such variables. (Rastogi, 1992). Table 4.6 shows the control variables identified from the multi-feedback loop model of impoverishment.

Table 4.6

Control Variables in the Multi-feedback Model of Impoverishment.

Sl.No.	Variable
1.	Faulty Planning & Implementation of Government's Development Schemes
2.	Impoverishment and Deprivation
3.	Lack of Assured Irrigation
4.	Frequent Crop Failure
5.	Lack of Fodder

The five control variables shown in the above table influence the 'self-reliance' and 'adaptability'* characteristics of systemic functioning. More specifically, these variables exercise a degree of control over systematic interaction.

3. Change-lever variables are those which are capable of producing cascading changes in the system. They combine the attributes of control and salience (Rastogi, 1992).

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* These two systemic properties are elaborated in Chapter 2.

In the multi-feedback loop model of impoverishment, the variable 'Faulty Planning & Implementation of Government's Development Schemes' emerges as the change lever variable. This has been demonstrated earlier that this is one of the salient variables and is functioning at a low level than desired in terms of meeting performance objectives of sustainable development. The 'change-lever' status of this variable, however, indicates that it constitutes a vantage point for introducing changes in the system.

4.4. Summary

This chapter has provided a detailed critical analysis of development problems and dynamics of impoverishment in the village cluster under study. The former is based on the findings during group discussions, key informants' interviews, and interviews with development functionaries. The latter, on the other hand, is based on the social cybernetic analysis of observed realities in the village cluster.

The consensus about development problems that emerged during group discussions with different social groups in the village cluster, clearly shows that village people find most development schemes as unsuitable to their felt requirements. The interviews with a few key informants revealed that most development programmes did not touch upon the activity areas of sustainable rural development in an integrated manner. Accordingly, the goals of sustainable development also remains

unachieved. The productivity improvement, enhancement of synergistic production, and sustainability of the resource use, are the worst affected goals of sustainable development due to existing development activities. The interviews with development functionaries, local government representatives, and voluntary workers at the top, middle, and lower levels, generated a large list of development related problems. The cluster-specific development, however, could not be identified from these interviews. Even the lower level development functionaries expressed the feeling that they were more involved in meeting the targets fixed by district level officials, and no one was really keen to assess the actual problems in the village.

The analysis of development problems has been supplemented in this chapter by social cybernetic analysis of the dynamics of impoverishment in the village cluster. The multi-feedback loop model is a particularised representation of impoverishment including factors empirically observed during the field work. The model provides a unified approach to explanation, prediction and problem-solving in the system. Six salient variables identified from the model define and explain the impoverishment problem in a synoptic manner. Identification of constraint, control, and change-lever variables provides additional diagnostic inferences about the problem situation. It is emphasized, however, that rectification of each salient variable is necessary for checking impoverishment process in the village cluster.

The role of development planning in this connection becomes two fold: (i) to prevent the passage of any salient variable towards its critical limit; and (ii) to increase the states of all salient variables towards their planned levels. Thus, constant monitoring and evaluation of identified salient variables provide a potent tool for development management in the village cluster. The salient variables based thrust of policy intervention is elucidated in the next chapter.

CHAPTER 5

PROBLEM DIMENSIONS, POLICY MEASURES, AND THRUST OF DEVELOPMENT INTERVENTION

5.1 Introduction

The existing development efforts and dynamics of impoverishment were analysed in the preceding chapter. In this chapter, an attempt has been made to extend this analysis by identifying the specific problem dimensions and corresponding policy measures. The purpose of this exercise is to determine the thrust of technology-based intervention strategy for sustainable development in the village cluster.

The rationale of intervention strategy emerges directly from the multi-cyclical representation of the problem of impoverishment in the village cluster. The salient variables of the dynamics of impoverishment provide the logical vantage point for identification of specific problem dimensions and corresponding policy measures. Disaggregation of each salient variable in terms of relevant empirical elements, leads to a mapping of the extant dimensions of the problem. The policy measures thence logically emerge as the solution requirements for rectifying the various aspects of the problem.* The emerging

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* The focus here is on the policy measures related to selection of suitable technologies and effectiveness of organisational apparatus for planning and implementation of development intervention in a specific context. This, however, does not mean that the policy measures like, land-reforms, institutional assistance, and public policy support are unimportant for the rural development efforts. But they do not form a part of our framework.

set of policy measures then serve to define the necessary and sufficient conditions for the solution of the problem in terms of the Ashby's Law of Requisite Variety.*

Section 5.2 of this chapter deals with the disaggregation of salient variables in the light of empirical evidences available about the problem. The village cluster specific problem dimensions and corresponding policy measures are identified with reference to each salient variable. In Section 5.3, the goal state of problem solving which directly emerge from the analysis of salient variables, is briefly discussed. The thrust of technology-based development intervention in the village cluster is briefly outlined in Section 5.4. This brings out the techno-structural nature of the identified policy measures. Section 5.5 summarises the discussion.

5.2 Problem Dimensions and Policy Measures

The first step towards formulating a suitable intervention strategy requires identification of specific problem dimensions and their relevant policy measures. The disaggregation of salient variables provides the basis for both of these requirements (Rastogi, 1986, and 1992). The salient variables underlying the

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* According to Ashby's Law of Requisite Variety (Ashby, 1956), each dimension of a problem situation (i.e problem's variety) must be effectively matched by a corresponding problem solving measure (i.e. response variety).

persistence of impoverishment in the village cluster are listed as below:

1. Faulty Planning and Implementation of Government's Development Schemes
2. Low Agricultural Productivity
3. Poor Quality of Life
4. Impoverishment and Deprivation
5. Inadequate Investible Capital
6. Unproductive Resource Use

As stated earlier, these salient variables provide a synoptic picture of persisting impoverishment in the village cluster. The actual status of these variables represent the current state of the problem situation, and their desired aspects represent the goal of problem solving. Disaggregation of these salient variables is based on the empirical evidence available about the extant problem. Identification of problem dimensions and corresponding control policies with reference to each salient variable is illustrated below:

1. Salient Variable : Faulty Planning and Implementation of Government's Development Schemes

This salient variable refers to the defective formulation and execution of currently operative government sponsored rural development schemes in the village cluster. Problem dimensions and corresponding solution measures emerging from the

disaggregation of this salient variable may be outlined as follows:

Problem Dimensions

I. The existing rural credit scheme aims at providing loans and subsidies to those who are below poverty-line for creating income earning assets. As a result off corruption at various levels, the credit received by the beneficiary is inadequate for starting a viable income earning activity. A few activities that have been started by beneficiaries are unsuccessful because no suitable technical advice is made available. In addition, no credit is made available for high employment potential activities like, crop diversification, expansion of animal husbandry, horticulture etc.

II. Schemes for the development of agriculture, dairy, sheep-rearing and horticulture have not succeeded in the village cluster as the technical know-how has not been made available for the same. Similarly, the programmes for sericulture, poultry, and floriculture development have not taken-off at all, despite the potential for the same.

III. The knowledge of new and renewable sources of energy (NRSE) has not been disseminated among villagers. The two biogas plants that have been set up, do not function at all.

IV. The implementation of potable water scheme has failed to cover all the hamlets of the village cluster.

V. The Primary schools in the village cluster lack basic facilities like, building, appropriate teaching aids, etc. As a result, the large number of children particularly girls, drop out of the school after two-three years.

VI. There is total absence of basic health care facilities in the village cluster despite Primary Health Centre (PHC) doctor's claim that village is regularly visited by auxiliary health staff.

VII. Schemes for setting up cooperative societies like, farmers' service society and dairy cooperatives have not benefited needy sections because of the control of these societies by dominant factions of the village.

VIII. Government sponsored development intervention has not paid any attention to creation of infrastructural facilities like, roads, transport, communication, electricity, sanitation, water supply, etc. The concerned departments do

have specific programmes for creation of these facilities, but they remain inoperative.

IX. Absence of villagers' involvement and non-availability of suitable tree varieties in the village result in the failure of government sponsored social forestry scheme.

X. Wasteland Reclamation Scheme has not succeeded because of poor inter-departmental coordination, and absence of continuous technological and input support.

XI. The canal irrigation scheme in the village has not benefited the farmers because water courses remain clogged and broken. The irrigation department pays no attention to these problems and in the absence of users' association, the problems remain unattended.

XII. Integrated Rural Development Programme (IRDP) and Jawahar Rojgar Yojana (JRY) are poorly implemented by Panchayat functionaries because of the absence of constant monitoring from government officials.

XIII. The Department of Soil Conservation has failed to provide soil-testing facilities to farmers on a regular basis. The use of modern soil treatment practices, therefore, is very rare in agricultural activities of the farmers.

XIV. Poor articulation of development needs and poor communication with government functionaries on the part of most villagers, result into the neglect of felt needs in programme formulation and implementation.

XV. The manifestation of the village factionalism in Panchayat functioning results into virtual absence of local pressure on programme implementation by government functionaries.

Policy Measures

(I) 1. Single window delivery system for availability of credit, as well as, technological inputs, to all the sections of the cluster's population.

2. Effective Management of Development Programmes

(II) 1. Single window delivery system for transfer of technologies relevant to agriculture, dairy, sheep-rearing, horticulture, sericulture, poultry, and floriculture development.

(III) 1.

2.

(IV) 1.

(V) 1.

2.

(VI) 1.

(VII) 1.

(VIII) 1.

(IX) 1.

2.

(X) 1.

2.

3.

(XI) 1.

2.

(XII) 1.

(XIII) 1.

(XIV) 1.

(XV) 1.

Improved programme management for the diffusion and implementation of new and renewable sources of energy (NRSE) technologies.

Single window delivery system for easy accessibility of related services.

Improved programme management for the cluster-wide coverage of potable water scheme.

Improved programme management for creating educational infrastructure.

Use of educational technology as teaching aid to all age, sex, and income groups in the village.

Improved delivery system for providing basic health care.

Organisational Development (OD) intervention to improve the effectiveness of existing cooperative societies.

Improved programme management for creating infrastructural base.

Villagers' participation in programme implementation.

Suitable afforestation technologies be made available.

Improved Programme management.

Sustained application of wasteland reclamation technology.

Formation of beneficiaries' association.

Improved programme management for irrigation development.

Formation of beneficiaries' association.

Improved programme management.

Single window delivery system for soil-testing and soil treatment technology.

Villagers' participation in programme formulation and implementation.

Ensuring regular and efficient functioning of local-self government institution, i.e. village panchayat.

The set of problem dimensions and solution/policy measures emerging from the disaggregation of salient variable 'Faulty Planning and Implementation of Government's Development Schemes' are listed in Table 5.1.

Table 5.1

Dimensions of, and Policies for, the Salient Variable 'Faulty Planning and Implementation of Government's Development Schemes'

	Problem Dimensions		Policy Measures
(I)	One-sided focus and poor management of rural credit provisions.	1.	Single window delivery system for technology transfer, training support and credit facilities, and provision of services to all sections of the village cluster.
(II)	Non-availability of technological know-how for existing, as well as potential production activities.	2.	Improved programme management.
(III)	Poor dissemination of the knowledge and skills for the use of new and renewable sources of energy (NRSE).	3.	Vigorous use of educational technology.
(IV)	Skewed implementation of potable water scheme.	4.	Organisation Development (OD) intervention in existing cooperative societies.
(V)	Inadequate educational facilities and poor teaching aids.	5.	Villagers' participation in programme formulation and implementation.
(VI)	Total absence of basic health care facilities.	6.	Vigorous use of afforestation technology in social and community forestry schemes.
(VII)	Poor effectiveness of Cooperative Societies.	7.	Sustained use of Wasteland Reclamation Technology .
(VIII)	Absence of sound infra-structural base.	8.	Formation of beneficiaries' associations.
(IX)	Absence of popular participation in Social Forestry and wrong choice of tree varieties.	9.	Ensuring regular and efficient functioning of village panchayat.
(X)	Poor inter-departmental coordination in implementation of wasteland reclamation scheme and lack of technological support.		
XI)	Poor management of canal irrigation system.		
XII)	Poor monitoring of poverty eradication schemes, such as IRDP and JRY.		

Table 5.1 (contd.)

Problem Dimensions	Policy Measures
(XIII) Soil-testing and soil-treatment practices are non-existent.	
(XIV) Villagers' inability to articulate their development needs and communicate with government functionaries.	
(XV) Defective functioning of Village Panchayat.	

* In this, as well as, in the subsequent tables, there is no one to one correspondence between the Problem Dimensions and Policy Measures. Moreover policy measures are listed in their unduplicated form.

2. Salient Variable : Low Agricultural Productivity

This salient variable refers to relatively low yields from agricultural operations than are actually possible in the village cluster. Problem dimensions and corresponding solution measures emerging from the disaggregation of this salient variable maybe outlined as follows:

Problem Dimensions

I. Vast patches of alkaline soil with pH value more than 9.0 causes degradation of land and reduces the area available for crop cultivation, affecting, in turn, the overall agricultural productivity negatively.

II. Prevalence of single cropping by small and marginal farmers leads to low agricultural yields in the village. This is mainly due to high costs of available inputs (e.g., HYV seeds, chemical fertilizers, irrigation), and perceived high risk, in intensive agriculture, and ignorance of modern dryland agriculture and other related technologies.

III. In double cropped areas owned by large and medium farmers, frequent crop failures cause low agricultural productivity. The crop failures are mainly caused by

drought-pronness of the area, inefficient use of available water for irrigation, nutrient deficiency, pest and weed attack, and non-availability of drought escaping varieties of seeds.

IV. Failure of farmers' service cooperative to provide credit, technological and training support, causes perpetuation of low-yield agricultural operations.

V. Poor infrastructural facilities combined with an inefficiently run agri-business centre (Mandi Samiti) cause the perpetuation of low yield agriculture in the village.

Policy Measures

(I) 1. Use of soil management technology

2. Use of water management technology

3. Use of wasteland reclamation technology

4. Integrated nutrient supply technology

(II) 1. Use of multiple and mixed cropping technology

2. Use of dryland agriculture technology

3. Same as in (I) 1, 2 and 4 above

4. Integrated pest control technology

(III) 1. Same as in (I) 1, 2 and 4 above

2. Same as in (II) 1, 2 and 4 above

3. Integrated weed control technology

4. Use of bio-technological inputs for high productivity agriculture.

(V) 1. Proper use of rural roads, rural communication and rural electrification technologies for creating adequate infrastructural base for productive agriculture.

2. Developing the agri-business centre as the nodal agency for marketing services required by farmers and entrepreneurs.

The set of problem dimensions and policy measures emerging from the disaggregation of salient variable 'Low Agricultural Productivity', are listed in Table 5.2.

Table 5.2

Dimensions of, and Policies for, the Salient Variable Low Agricultural Productivity

Problem Dimensions		Policy Measures
(I)	Vast patches of alkaline soil and wastelands.	1. Soil Management Technology
(II)	Prevalence of single cropping among marginal and small farmers.	2. Water Management Technology
(III)	Frequent crop failure in double cropped areas	3. Wasteland Reclamation Technology
(IV)	Ineffectiveness of farmers' service society	4. Integrated Nutrient Supply Technology
(V)	Poor infrastructural facilities.	5. Multiple and Mixed Cropping Technology
(VI)	Inefficiently run agri-business centre	6. Dryland Agriculture Technology
		7. Integrated Pest Control Technology
		8. Integrated Weed Control Technology
		9. Biotechnological inputs
		10. Organisation Development (OD) intervention in farmers' service society
		11. Rural Roads Technology
		12. Rural Communication Technology

Table 5.2 (contd.)

Problem Dimensions	Policy Measures
	13. Rural Electrification Technology
	14. Developing agri-business centre as the nodal agency for marketing of farmers' produce

3. **Salient Variable : Poor Quality of Life**

This salient variable refers to a general condition of villagers' poor accessibility of facilities meant to improve standard of life such as, health care, education, safe drinking water, domestic fuel energy, etc. Problem dimensions and corresponding solution measures emerging from the disaggregation of this salient variable may be outlined as follows:

Problem Dimensions

I. Wide-spread ignorance of basic health care and family welfare methods cause neglect of illness, disease, child and mother care, etc. As a result, the life expectancy is low in the village. Moreover, at the time of accidents, no immediate health care is available.

II. Use of cow-dung cakes as predominant source of domestic fuel causes health hazards, especially to women and children who are directly involved in the preparation and use of these fuel cakes.

III. Educational facilities for village children are sub-standard. Primary education imparted in schools does not help children to relate to their surroundings. This causes high drop out rate at the primary level itself.

Moreover, there is no literacy programme for adult population of the village.

IV. The use of water drawn from unclean wells and ponds is very common for domestic purposes. This is mainly because of the inadequate potable water facilities. Currently, only two hamlets of the cluster have hand pumps - for safe drinking water.

V. Poor sanitary conditions in the hamlets.

VI. The houses owned by villagers are prone to catch fire.

Policy Measures

(I) 1. Knowledge and use of Basic Health Care Technology

2. Knowledge and use of Family Welfare Technology

3. Knowledge and use of Hazards and Accidents Protection Technology

(II) 1. Solar Energy Use Technology

2. Biogas Use Technology

3. Use of Smokeless Chulha (wood stove) for domestic cooking

(III) 1. Vigorous use of Educational Technology for formal, as well as, informal education

(IV) 1. Widespread use of Potable Water Technology.

(V) 1. Waste Recycling Technology

2. Vigorous expansion and use of Rural Sanitation Technology

(VI) 1. Use of Low-Cost Housing Technology for construction of safe houses.

The set of problem dimensions and policy measures emerging from the disaggregation of salient variable 'Poor Quality of Life', are listed in Table 5.3.

Table 5.3

Dimensions of, and Policies for, the Salient Variable 'Poor Quality of Life'

Problem Dimensions		Policy Measures
(I)	Indifference toward basic health care and family welfare	1. Basic Health Care Technology
(II)	Unhealthy fuel use practices	2. Family Welfare Technology
(III)	Poor educational facilities and deficient methods of imparting primary education	3. Hazards and Accidents Protection Technology
(IV)	Inadequate potable water facility and frequent use of unclean water for domestic use	4. Solar Energy Use Technology
(V)	Poor sanitary conditions in hamlets of the village cluster	5. Biogas Use Technology
(VI)	Large number of houses are prone to catch fire	6. Smokeless Chulha (Wood Stove)
		7. Educational Technology
		8. Potable Water Technology
		9. Waste Recycling Technology
		10. Rural Sanitation Technology
		11. Low-cost Housing Technology

4. **Salient Variable : Impoverishment and Deprivation**

This salient variable refers to the predicament of that section of village population which suffers from extreme deprivation and impoverishment. Problem dimensions and

corresponding solution measures emerging from the disaggregation of this salient may be outlined as follows:

Problem Dimensions

I. Meager household income coupled with unemployment and underemployment results into extreme impoverishment among resource poor households.

II. Prevalence of wage labour and share-cropping among those who own small areas of land allotted by revenue department, but are not able to use it either because of inability to afford required inputs or ignorance of other possible uses of land.

III. The government sponsored programmes (viz., IRDP and JRY) especially meant for poverty eradication and employment generation, fail to improve the conditions of impoverished sections because of latter's dependence on government machinery and consequent inability to organise themselves for common benefits.

Policy Measures

(I) 1. Single window delivery system for dissemination and use of employment generating technologies like, Livestock Development Technology, and Poultry.

(II) 1. Use of Dryland Agriculture Technology

2. Use of Sericulture Development Technology

3. Use of Floriculture Development Technology

4. Adequate credit and technological support by a single window delivery system

(III) 1. Formation of beneficiaries' association

The set of problem dimensions and policy measures emerging from the disaggregation of salient variable 'Impoverishment and Deprivation', are listed in Table 5.4.

Table 5.4

Dimensions of, and Policies for, the Salient Variable 'Impoverishment and Deprivation

Problem Dimensions	Policy Measures
(I) Meager household income coupled with unemployment among resource poor families.	1. Livestock Development Technology.
(II) Inability of small and marginal farmers to use their lands, causing prevalence of wage labour and share cropping	2. Poultry Development Technology 3. Dryland Agriculture Technology
(III) Poor's dependence on government machinery and inability to organise themselves for common benefits provided by the government.	4. Sericulture Development Technology 5. Floriculture Development Technology 6. Single window delivery system for making credit and technologies available to users. 7. Formation of beneficiaries association.

5. **Salient Variable : Inadequate Investible Capital**

The salient variable refers to the failure of socio-ecological system to generate surplus capital for investment in income generating activities. Problem dimensions and

corresponding solution measures emerging from the disaggregation of this salient variable may be outlined as follows:

Problem Dimensions

I. Persistence of subsistence form of economic operations such as agriculture, animal husbandry, and horticulture in the village cause inadequate surplus generation and low household income impeding in turn the investment potential of majority of the villagers.

II. Non-availability of credit to big land-owners for large-scale expansion of agriculture, animal husbandry, horticulture etc., prevents the initiation of high investment, high returns production profile in the village cluster.

III. Virtual absence of post-harvest processing units thwarts the possibility of value-added production, thus leading to inadequate wealth creation from the existing economic activities.

Policy Measures

(I) 1. Sustained use of agroforestry, multiple and mixed cropping, dryland agriculture, livestock development, horticulture and other related technologies for making activities concerned more productive and remunerative.

(II) 1. Single window delivery system for credit and relevant technologies for large scale expansion and diversification of agriculture, animal husbandry, and horticulture.

(III) 1. Use of post harvest technology for production of value-added products and income generation.

The set of problem dimensions and policy measures emerging from the disaggregation of salient variable 'Inadequate Investible Capital' are listed in Table 5.5.

Table 5.5

Dimensions of and Policies for the Salient Variable Inadequate Investible Capital'

Problem Dimensions	Policy Measures
I. Inadequate surplus generation and low household income because of the persisting subsistence form of economic operations	1. Multiple and Mixed Cropping Technology
II. Non-availability of credit for the large scale expansion of agriculture, animal husbandry and horticulture	2. Dryland Agriculture Technology
III. Virtual absence of post-harvest value-added production	3. Livestock Development Technology
	4. Horticulture Development Technology
	5. Single window delivery ensuring the availability of credit and relevant technologies
	6. Post-Harvest Technology
	7. Agroforestry

6. **Salient Variable : Unproductive Resource Use**

This salient variable refers to the unproductive and unsustainable use of available resources like, land, water, animals, trees, groves etc., in the village cluster. Problem dimensions and corresponding policy measures emerging from the disaggregation of this salient variable may be outlined as follows:

Problem Dimensions

I. Common property resources of the cluster such as, grazing land, wasteland, ponds, and groves remain unutilized because of the fear of factional feuds and social tension.

II. Villagers are not able to use privately owned resources such as, crop lands, cattle, sheep, pigs, and fruit trees productively because of the ignorance and non-availability of suitable technologies and related training support.

III. Absence of infrastructural facilities like, roads, transport, electricity, and communication results in unproductive use of available resources.

Policy Measures

(I) 1. Formation of village level institutions for participatory management and use of common property resources.

2. Use of grassland development, afforestation, wasteland reclamation, water management, and horticulture development technologies for productive utilization of common property resources of the village.

(II) 1. Vigorous use of multiple and mixed cropping, dryland agriculture, agroforestry, sericulture, floriculture, horticulture, livestock development technologies for productive utilisation of privately owned resources.

2. Single window delivery system for imparting knowledge and skills required for the use of technologies in related activities.

(III) 1. Proper use of rural roads, rural communication, and rural electrification technologies for creation of infrastructural base so that productivity of existing resources may be enhanced.

The set of problem dimensions and policy measures emerging from the salient variable 'Unproductive Resource Use' are listed in Table 5.6.

Table 5.6
Dimensions of and Policies for the Salient Variable 'Unproductive Resource Use'

Problem Dimensions	Policy Measures
(I) Common property resources of the village such as, grazing land, wasteland, ponds and groves remain unutilised	1. Formation of village level institution for participatory management and use of common property resources
(II) Ignorance and non-availability of relevant technologies and training support for the productive use of privately owned resources like, land, cattle, sheep, pigs, fruit trees etc.	2. Grassland Development Technology 3. Wasteland Reclamation Technology 4. Water Management Technology
III) Absence of infrastructural facilities	5. Horticulture Development Technology 6. Afforestation Technology 7. Multiple and Mixed Cropping Technology 8. Dryland Agriculture Technology 9. Agroforestry 10. Sericulture Development Technology 11. Floriculture Development Technology 12. Livestock Development Technology 13. Single window delivery system for imparting knowledge and skill required for the use of technologies 14. Rural Road Technology 15. Rural Communication Technology 16. Rural Electrification Technology

It is apparent from the disaggregation analysis that system malfunctioning and low viability status of six salient variables are caused by multiple and sometimes overlapping set of cluster-specific socio-ecological factors. Put together in unduplicated form, they define the facets or dimensionality of the whole problem situation. Similarly, technological and organisational requirements that logically emerge as solution measures constitute a policy package in their unduplicated form.

Table 5.7 lists the identified sets of problem dimensions and policy measures respectively in their unduplicated forms. There are twenty-eight facets of the extant problem situation.

Table 5.7
Dimensions of the Problem of Impoverishment in the Village Cluster

Sl. No.	Problem Dimensions
I	One-sided focus and poor management of rural credit provisions
II	Non-availability of technological know-how and related training support for existing, as well as, potential production activities
III	Ignorance about the utility of new and renewable sources of energy (NRSE) and relevant technologies
IV	Insufficient coverage of potable water facility
V	Poor arrangements for formal and adult education
VI	Non-availability of basic health care facility
VII	Failure of existing cooperative societies in providing required benefits to people
VIII	Virtual absence of sound infrastructural base
IX	Absence of popular participation and non-availability of relevant technology for social forestry

X	Poor inter-departmental coordination and non-availability of relevant technology for wasteland reclamation
XI	Deficient canal irrigation system and absence of user's association
XII	Lack of monitoring by officials in poverty eradication schemes
XIII	Soil-testing and soil treatment practices non-existent
XIV	Poor articulation of development needs and poor communication with government functionaries
XV	Partisan role of village Panchayat and its defective functioning
XVI	Vast patches of alkaline soil and wastelands
XVII	Prevalence of single cropping
XVIII	Frequent crop failure in double cropped areas
XIX	Inefficiently run agri-business centre
XX	Wide-spread ignorance of basic health care, family welfare, and hazard protection methods
XXI	Unhealthy fuel use practices are quite common
XXII	Insanitary human settlements
XXIII	Quite a large number of houses are prone to catch fire
XXIV	Meager household income in land-less families
XXV	Prevalence of wage labour and share cropping among marginal and small farmers because of the ignorance of productive land-use
XXVI	Deprived groups' dependence on government machinery and inability to organise for common benefits
XXVII	Persistence of subsistence economy of the village
XXVIII	Unutilized and/or under-utilized Common Property Resources (CPR) of the village

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The policy measures which address one or more of these facets are forty in number. Of these, thirty two are technological

in nature, while remaining eight indicate organisation development, institution-building, and delivery system design aspects of solution requirements. Table 5.8 lists both technological and organisational measures.

Table 5.8

Policy Measures for the Problem of Impoverishment in the Village Cluster

Sl. No.	Policy Measures
1.	Single window delivery system for credit, technology transfer and other services in the village
2.	Improved programme management
3.	Educational Technology
4.	Organisation Development (OD) intervention in existing cooperative societies in the village
5.	Villager's participation in programme formulation and implementation
6.	Afforestation Technology
7.	Wasteland Reclamation Technology
8.	Formation of beneficiaries' associations
9.	Ensuring regular and efficient functioning of local self-government institution (Panchayat)
10.	Soil Management Technology
11.	Water Management Technology
12.	Integrated Nutrient Supply Technology
13.	Multiple and Mixed Cropping Technology
14.	Dryland Agriculture Technology
15.	Integrated Pest Control Technology
16.	Integrated Weed Control Technology
17.	Biotechnology

Table 5.8 (contd.)

18. Rural Roads Technology
19. Rural Communication Technology
20. Rural Electrification Technology
21. Developing agri-business centre as a nodal agency for marketing services
22. Basic Health Care Technology
23. Family Welfare Technology
24. Hazards and Accidents Protection Technology
25. Solar Energy Use Technology
26. Biogas Use Technology
27. Smokeless Chulha (Wood Stove)
28. Potable Water Technology
29. Waste Recycling Technology
30. Rural Sanitation Technology
31. Low-cost Housing Technology
32. Livestock Development Technology
33. Poultry Development Technology
34. Sericulture Development Technology
35. Floriculture Development Technology
36. Agroforestry
37. Post Harvest Technology
38. Formation of village level institutions for participatory management and use of common property resources
39. Grassland Development Technology
40. Horticulture Development Technology

It is important to note here that the lists of problem dimensions and policy measures do not represent any ranking or order of importance. They also do not indicate any one-to-one correspondence between the dimensions and policies. As a matter of fact, some policy measures like, 'single window delivery system for credit, technology transfer and services' and 'improved programme management' are applicable to more than one dimension of the problem as seen in disaggregation of salient variables. This fact of plural applicability of certain policy measures is meaningful. It helps determine the differential relative significance of identified policy measures and differential relative seriousness of problem dimensions.

5.2.1 Differential Relative Intractability of Problem Dimensions and Relative Significance of Policy Measures

Determination of the differential relative seriousness and/or intractability of problem dimensions, as well as, of differential significance of policy measures, is vitally necessary in the context of the optimal allocation of resources and efforts for problem-solving. Policy-makers and problem-solvers inevitably face a situation of limited resources at their disposal. A knowledge of the relative importance of policies and problem dimensions in this context enables them to use the available resources in an optimal manner and make the most of them.

Differential relative intractability of problem dimensions and differing relative significance of policy measures, may be determined by a binary matrix analytic procedure of Operations

Research. This procedure is based on the concept of plural applicability of a solution/policy measure to more than one facet of the problem.

In the context of the problem of impoverishment and under development in the village cluster, a binary matrix of policies vs. dimensions is set up. The binary matrix based on Table 5.7 and 5.8, is represented by Table 5.9.

The rows of the matrix show the applicability of the indicated policies to concerned dimensions of the problem. The columns of the matrix analogously show the number of policies needed for dealing with specific problem dimensions. The relative intractability of a particular problem dimension is indicated by the sum total of policies required for its rectification. The greater the number of policies, the more intractable the problem dimension. Similarly, the relative significance of a policy measure is indicated by its greater potential applicability to various problem dimensions. The sum total of the number of dimensions a particular policy measure addresses, shows its plural applicability potential and relative significance.

(Any Reference ?)

Table 5.9
Policies Vs. Dimensions Matrix

P \ D	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII	TOTAL
1.	+	+	+				+	+	+	+	+		+			+	+	+			+	+	+	+	+		+		18
2.	+	+	+	+	+	+		+	+	+	+	+								+				+					13
3.		+	+		+	+			+				+	+	+	+	+	+		+	+	+		+	+	+	+	+	19
4.		+					+							+	+		+	+	+					+	+	+	+		11
5.	+		+	+	+			+	+	+	+	+		+								+		+		+	+	+	15
6.		+	+						+	+	+					+		+			+				+		+	+	11
7.		+								+			+			+									+		+	+	7
8.	+	+								+	+	+		+	+				+					+		+			10
9.		+							+		+	+		+	+							+				+		+	9
10.		+								+			+			+	+	+							+		+	+	9
11.		+								+	+					+	+	+							+		+	+	9
12.		+								+			+			+	+	+							+		+		8
13.		+								+			+				+	+							+		+		7
14.		+											+				+	+							+		+		6
15.		+															+	+							+		+		5
16.		+															+	+							+		+		5
17.		+											+				+	+									+		5
18.								+											+								+		3
19.								+			+	+		+				+	+	+							+		8
20.								+																			+		2
21.								+									+	+	+								+		5

Table 5.9 (contd.)

P ↓ \ D →	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII	TOTAL
22.						+														+	+	+							4
23.						+														+									2
24.																				+	+	+	+						4
25.		+	+																		+								3
26.			+																	+	+	+							4
27.																				+	+								2
28.				+																+		+							3
29.			+																		+	+						+	4
30.																				+		+							2
31.																							+						1
32.		+															+	+			+			+	+		+		7
33.		+																						+	+		+		4
34.		+														+	+							+	+		+		6
35.		+															+							+	+		+		5
36.		+								+							+	+			+				+		+		7
37.		+															+	+	+					+	+		+		7
38.									+	+	+			+	+						+					+	+	+	9
39.		+							+	+						+	+	+							+		+	+	9
40.									+								+								+		+	+	5
Total	4	24	8	3	3	4	2	7	9	13	9	5	8	7	5	9	19	18	6	10	12	10	3	11	20	6	27	11	273

The binary matrix analysis reveals that the most intractable dimensions of the problem's structure are the following:

I Persistence of the subsistence economy of the village..... (27)

II Non-availability of technological know-how and related training support for existing, as well as, potential production activities ..... (24)

III Prevalence of wage labour and share-cropping among marginal and small farmers because of the ignorance of productive land use ..... (20)

IV Prevalence of single cropping ..... (19)

V Frequent crop failure in double croppedareas ..... (18)

VI Absence of popular participation and non-availability of relevant technology for social forestry ..... (13)

VII Unhealthy fuel use practices are quite common ..... (12)

VIII Meager household income in landless families ..... (11)

IX Unutilised and/or under-utilised Common Property resource (CPR) of the village ..... (11)

The most significant policy measures in the context of the given situation are:

1. Educational Technology ..... (19)

2. Single-window delivery system for credit, technology transfer and other services in the village ..... (18)

3. Villagers' participation in programme formulation and implementation ..... (15)

4. Improved programme management ..... (13)

5. Organisation Development (OD) intervention in the existing cooperative societies in the village ..... (11)

6. Afforestation Technology ..... (11)

7. Formation of beneficiaries' association ..... (10)

8. Ensuring regular and efficient functioning of local-self-government institution (Panchayat) .... (9)

9. Soil Management Technology ..... (9)

10. Water Management Technology ..... (9)

11. Formation of village-level institutions for participatory management and use of Common Property Resource (CPR) ..... (9)

12. Grassland Development Technology ..... (9)

The insights emerging from the binary matrix analysis of policies and dimensions, may be used in preliminary planning for system transformation in the given situation. It may be emphasized, however, that conjunctive implementation of all policy measures is basic to the control of a problem situation. Therefore, all solution/policy measures must be implemented in a timely and effective manner. If any one of them cannot be implemented, or is implemented ineffectively, the facet or dimension of the problem meant to be addressed by it, remains undealt with, and continues to transmit its malfunctioning within the problem's structure.

The requirement of conjunctive, effective, and timely implementation of problem-solving measures, limits the scope of problem's control and rectification. In view of this limitation, the exploration of mutually supportive or synergistic relationships among policy measures becomes the logical necessity for rational plan formulation and effective programme implementation. The conjunctive approach to problem solving in the present context, thus, calls for the identification of

synergistic technological modules and a comprehensive organisational design for successful adoption and implementation of identified modules.

The technological and organisational dimensions of problem solving are discussed in the succeeding chapters.

5.3 Goal State of Problem Solving

What is the goal-state of problem-solving if all the identified policy measures are implemented in a conjunctive, effective, and timely manner? In the present context, the goal-state of system transformation is logically definable in terms of desired/planned state of the six salient variables of the problem's structure.

The forty problem-solving measures outlined above aim toward bringing about the goal-state of problem solution. At the macro level, the goal-state orients the process of policy formulation and initiation. It provides the basic direction for problem-solving efforts. The solution state of the problem at the macro level may thence be visualized in terms of the desired/planned state of its salient variables as follows:

(i) Formulation and execution of government's development schemes in such a manner that felt needs of the beneficiaries are met and location-specific developmental requirements are effectively incorporated in the planning and implementation of schemes. The objective here is to achieve logico-rational congruence between programmes' goals, and local needs and aspirations.

(ii) Continuous and sustainable increase in the productivity of agriculture so that growing agricultural surplus is created, and income base of the farming families expanded.

(iii) Continuing improvements in the quality of life of rural households in a manner such that their access to basic health care, education, potable water, domestic fuel, sanitation, and other infrastructural facilities are ensured, and upgraded in a regular manner.

(iv) Empowerment of impoverished and deprived sections so that their affordability of basic necessities of life is enhanced in a continuing manner and the level of deprivation diminishes progressively.

(v) Continuing generation of wealth and resources through productivity and innovation so that the quantum of investible capital available to the rural households continues to grow.

(vi) The productivity of all the available productive resources to be amplified so that ecologically sustainable process of development proceeds along a spiralling path.

Such a delineation of the macro level goal state of problem solving defines the basic orientation of the development intervention strategy. The policy parameters are accordingly formulated keeping in view the desired states of the malfunctioning system's salient variables. The micro level focus is determined by the nature of location-specific problem dimensions. The effective rectification of each of these problem dimensions by a set of suitable technological and organisational policy measures, may be equated with the accomplishment of the goal state of problem-solving at the micro-level.

5.4 Thrust of Development Intervention

The basic thrust of the proposed intervention strategy is clear from the set of forty policy measures identified for

rectifying cluster-specific problem dimensions. There are essentially two types of policy measures. A majority of them (thirty-two) are technological measures signifying the urgent need for the selection and use of relevant technologies to bring about the goal-state of problem solution. The other type of measures (eight) are concerned with organisation development (OD) intervention; institution-building at the local level; and design of delivery system for technology transfer. These eight organisational measures may be combined together in the category of 'social technology' required for the achievement of the goal state in the village cluster. The conjunctive use of both types of measures in the intervention strategy may be defined as 'techno-structural'* changes in the planning area.

The techno-structural thrust of the intervention strategy follows from the overall focus of analysis on identifying suitable technologies and organisational requirements for technology transfer. The nature of cluster-specific problem dimensions is such that if one were to achieve the goal-state of problem solving, technological means, and organisational modes constitute the most viable solutions available in the given time and space. It is possible to think of other measures like, land-reforms, institutional assistance, and public policy support, but such measures have not quite succeeded in Indian rural society. It has

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* Techno-structural changes refer to intervention programmes focusing on both the technology as well as the structure of organisation for implementation (Cummings and Huse, 1989).

been shown in a number of evaluation studies that judicial delays, corruption, inefficiency, and political pressures, negatively affect the execution of these measures. The use of suitable technologies, on the other hand, attacks the core problem of rural impoverishment through another route. The combined application of technical know-how, and new innovations emerging from research organisations, may bring about sustainable transformation in stagnant situations. The management support in the form of institution-building, organisation development intervention, and new delivery system, may provide better service effectiveness, which in turn, may further lead to the continued efficiency of technology implementation and innovation diffusion.

The next two chapters discuss and elaborate the suggested techno-structural changes in the context of the given village cluster.

5.5 Summary

In this chapter, specific problem dimensions have been identified on the basis of empirical examination of the factors causing malfunctioning in the village cluster. The salient variables which synoptically represent this malfunctioning are disaggregated to identify these problem dimensions. The policy measures to rectify each of these problem dimensions, logically emerge from the analysis. Their effective and conjunctive implementation provides the necessary and sufficient conditions for achieving the goal state of problem solution. All these themes

emerge from the analysis. Finally, the intervention strategy consisting of the identified policy measures defines the overall thrust of development intervention, and is in the form of techno-structural changes in the village cluster.

CHAPTER 6

TECHNOLOGICAL MODULES FOR SUSTAINABLE DEVELOPMENT IN THE VILLAGE CLUSTER

6.1 Introduction

The techno-structural nature of the required intervention strategy for sustainable development in the village cluster has been discussed in the preceding chapter. The set of policy measures that constitute the thrust of development intervention include both technological and organisational solutions for the desirable process of sustainable transformation in the village cluster. The former are concerned with appropriate technological planning for the village cluster, whereas the latter are related to different aspects of social planning for organisational innovation to implement technology intensive strategy of sustainable rural development. This chapter focuses on the technological dimension of the proposed thrust of development intervention and related sociological issues in the given context.

The nature and relevance of identified technologies are discussed in Section 6.2. Later, an attempt is made to identify mutually supportive or synergistic linkages among technologies seen to be relevant for the village cluster. Based on these linkages, a few technology modules (TM) are developed in Section 6.3. This seeks to be an exercise into technological planning for achieving goals of sustainable development in the cluster. The sociological issues related with technology transfer in the present context are briefly elucidated in Section 6.4. Finally,

Section 6.5 summarises the technological dimension of sustainable rural development in the village cluster.

6.2 Identified Technologies and their Relevance

The technologies required for sustainable development in the village cluster as identified on the basis of empirical disaggregation of problem's salient variables are listed in Table 6.1.

Table 6.1

Technologies Required for Sustainable Development in the Village Cluster

Sl. No.	Technologies
1.	Afforestation Technology
2.	Agroforestry
3.	Basic Health Care Technology
4.	Bio-gas Use Technology
5.	Biotechnology
6.	Dryland Agriculture Technology
7.	Educational Technology
8.	Family Welfare Technology
9.	Floriculture Development Technology
10.	Grassland Development Technology
11.	Hazards and Accidents Protection Technology
12.	Horticulture Development Technology
13.	Integrated Nutrient Supply Technology
14.	Integrated Pest Control Technology
15.	Integrated Weed Control Technology
16.	Livestock Development Technology
17.	Low-cost Housing Technology
18.	Multiple and Mixed Cropping Technology
19.	Post Harvest Technology
20.	Potable Water Technology
21.	Poultry Development Technology
22.	Rural Communication Technology
23.	Rural Electrification Technology
24.	Rural Roads Technology
25.	Rural Sanitation Technology
26.	Sericulture Development Technology

27. Smokeless Chulha (Wood Stove)
28. Soil Management Technology
29. Solar Energy Use Technology
30. Wasteland Reclamation Technology
31. Waste Recycling Technology
32. Water Management Technology

The technologies listed in the above table represent the set of solution measures for cluster-specific problem dimensions. They include not only devices but also knowledge and skills available with development professionals and social actors in the village cluster. In combination, they constitute the means of attaining the goal of problem solving in the village cluster. The transfer, acceptance, and effective implementation of these technologies will, however, depend upon the understanding of their nature and appropriateness in the present context. Therefore, the nature of each of these technologies is discussed below, before assessing their relevance to activity areas for sustainable rural development in the given context. Here, it may be pointed out that in the description of the nature of identified technologies, the technical parameters and designing elements have not been dealt with. The focus, on the contrary, is on creating an information base about their nature in a manner so that they can be incorporated as policy inputs in the formulation of intervention strategy for sustainable development in the village cluster.

6.2.1 Nature of Identified Technologies

The brief description of technologies identified for solving cluster-specific problem dimensions is as follows:

(1) Afforestation Technology

This refers to the methods and processes required for propagation, regeneration, and management of 'trees and related plant and animal populations in ways that perpetuate the forest ecosystem' (Uphoff, 1987). Forest products such as, fuel, fodder, and building materials (timber and thatch) are important for livelihood of rural population. The use of afforestation technology consisting of species selection; seed collection and storage; nursery management; planting and maintenance of plantation, etc., in social and community forestry is very useful for achieving the goals of sustainable rural development (Khan, 1987).

(2) Agroforestry

This is a sustainable land management system which increases the yield of land, combine the production of crops (including tree crops) and forest plant and/or animals simultaneously or sequentially on the same unit of land, and applies management practices that are compatible with cultural practices of the local population (Bene et. al., 1977; King and Chandler, 1978). Three basic sets of components are managed in all agroforestry systems namely, herbacous plants, woody perennials, and animals. It is

logical, therefore, to classify agroforestry based on the natur of these components, namely agri-silvicultural, silvo-pastoral an agro-silvo-pastoral systems (Nair, 1985).

The characteristics common to all agroforestry systems are: (i) at least, one species of an agroforestry system must be a woody perennial and the other being plants or animals or both; (ii) the components are grown simultaneously in some form of spatial arrangement or sequentially, on the same land; (iii) there are two or more outputs of all agroforestry systems; and (iv) there is a complex ecological and economic interaction between the components (Khan, 1987).

(3) Basic Health Care Technology

This includes measures for prevention and cure of diseases to safeguard the health of infants, pregnant and lactating mothers, and aged people. These measures are: vaccination against common diseases, provision of life saving drugs; aids for physically handicapped, and availability of regular health care advice from trained medical staff (CSIR, 1984).

(4) Bio-gas Use Technology

The bio-gas plant also referred to as Gobar Gas Plant has been found most appropriate in rural areas as it enables the multiple and efficient use of animal dung. It and produces fuel in the form of gas, simultaneously with high-quality manure. It is comparatively a low-capital-intensive technology for meeting

domestic energy requirements of rural households (CSIR, 1984).

(5) Biotechnology

Biotechnology is a knowledge-intensive approach to the use of a package of powerful techniques for manipulation and alteration of life forms and applies engineering principles to such life forms for the processing of materials to provide the desired end products and services in the field of agriculture, forestry, horticulture, floriculture, livestock breeding, poultry and other related areas (Ramchandran, 1989). The most commonly known techniques which have vast applications in the above mentioned fields are: (i) Protoplast, cell and tissue culture; (ii) Recombinant DNA or Genetic Engineering; and (iii) Microbiological processes of upgradation/modification of cellulosic materials and agricultural biomass (Swaminathan, 1988).

Some of the products which are now available as a result of biotechnology research are: bio-pesticides; bio-fertilizers; stress-tolerant, disease and pest-resistant varieties of crops; transgenic animals; immuno-diagnotics for detection of diseases in plants and animals; and embroyo transfer for herd improvement and better milk production (Ramchandran, 1989).

(6) Dryland Agriculture Technology

The dryland agriculture technology offers attractive prospects of boosting foodgrains production from drylands. This includes knowledge and skills pertaining to improved soil and crop

management practices; moisture conservation and use; new cropping patterns; run-off water harvesting; inter-cropping; using crop varieties of photo-insensitive nature, which have shorter duration, and ability to escape droughts, etc.

In dryland crop production, there is no substitute for efficient management - timeliness in field bed preparation, sowing, weed control, top dressing, diseases and pests control, and harvest. The precision in the rate and depth of seeding and fertilizer placement is also necessary (Singh, 1988).

In dryland agriculture, the use of those technologies is encouraged which create additional employment opportunities in rain-fed agro-climatic situation.

(7) Educational Technology

This includes audio-visual aids, functional literacy methods, curriculum designing for primary and secondary education, teaching aids and demonstrations as part of the overall extension work in the rural areas.

(8) Family Welfare Technology

This includes methods and devices of birth control, nutrition supplements in weaning foods, fortification of common salt, supplementation with vitamins and proteins, etc. These are particularly used for the welfare of women and children (CSV, 1982; CSIR, 1984).

(9) Floriculture Development Technology

Ornamental flowers have a vast domestic as well as foreign markets. The floriculture development technology includes methods for propagation, planting, pruning, manuring, watering, plucking and packaging of several varieties of flowers for marketing and other commercial use. Because of the available technology, flower cultivation has now great potential for generating remunerative self-employment among small and marginal farmers, besides earning the foreign exchange (Padmanabhan, 1991).

(10) Grassland Development Technology

This involves a package of practices which include selection of suitable sites; closure of area from biotic influences; removal of unwanted and obnoxious vegetation; moisture conservation; upgrading the herbage quality and yield through HYVs and nutrient-rich grasses; legumes and fodder trees forming a multi-tier system; proper grazing management practices; conservation and carry over of forage for lean periods; and arrangements for distribution and/or availability among the watershed farmers in times of droughts and fodder scarcity (Narayana et. al., 1990).

(11) Hazards and Accidents Protection Technology

This consists of methods and procedures to minimize and/or prevent the damage from such hazards as fire, toxins in food, poisoning by insect or reptile bites, dehydration, etc. The most common methods are fire retardant treatment; toxin removal methods

from groundnut, edible oils, mustard oil, and Khesari dal; insect replants; poisoning cure methods; and oral rehydration therapy (CSV, 1982).

(12) Horticulture Development Technology

This involves the production, harvesting, storage, grading, packaging, and transportation for marketing of vast varieties of fruit, and vegetable crops. The technology support in the form of new hybrids, storage, processing and packaging is available for use. Horticulture provides not only the protection to degraded lands but also acts as a good source of income from these lands. (Narayana et. al., 1990).

(13) Integrated Nutrient Supply Technology

This involves the use of an optimum blend of bio-fertilizers, organic manures and mineral fertilizers in crop production (Swaminathan, 1985). This promises both saving of cost and increase in productivity of agricultural operations.

(14) Integrated Pest Control Technology

This involves an appropriate admixture of genetic, chemical, agronomic, and biological methods of pest control (Swaminathan, 1982). Dramatic increases in yields are obtained when appropriate pest control methods are adopted in an integrated manner.

(15) Integrated Weed Control Technology

This involves the utilisation of a combination of physical, chemical and cropping methods of weed control in a well-planned sequence so designed as not to affect the ecosystem. The nature and intensity of the species to be controlled, the sequence of crops that are raised in the rotation, the standard of crop husbandry, the ready and timely availability of any method, and the economics of the different weed control methods are some of the potent considerations that determine the successful exploitation of the integrated weed control approach (ICAR, 1992).

(16) Livestock Development Technology

This encompasses the entire area of animal husbandry, which covers animal (including cattle, buffalo, sheep, goats and pigs) improvements through technologies associated with manipulation of genes, gene products, and related technologies of reproduction, draft quality and milk/meat/wool production (Bhat, 1988). This also includes methods of improved animal nutrition and animal products technology (ICAR, 1986-87).

The animal health care techniques are also part of livestock development technology. The emphasis is on 'prophylactic maintenance to minimize the need for drugs' (Jazairy et. al., 1992). The vaccination against common animal diseases are now available for use in the case of cattle, sheep, pig, goats and buffalo (ICAR, 1986-87).

(17) Low-Cost Housing Technology

This includes considerations for rural construction materials, use of new substitute materials, and optimum utilisation of scarce materials. Efforts have also been made to improve construction techniques (e.g., fire-retardent thatch roof, and water-repellent mud walls), maintenance practices etc. (CSV, 1982; CSIR, 1984).

(18) Multiple and Mixed-Cropping Technology

These aim at maximizing production per unit of land and per unit of time from the same piece of land in a year. Whereas multiple cropping involves the knowledge and skill for taking three or four crops from the same piece of land, the mixed cropping involves raising two or more crops in the same season by using methods of inter-cropping and relay-cropping.

The rationale for adopting multiple and mixed cropping is not merely to increase land-use intensity. Other reasons for doing so include taking full advantage of the wide variations in temperature and agro-climatic conditions from one part of the year to the other, the immense manpower available for farming, and the existence of demand for a wide variety of agricultural products (Bhatia, 1988). The application of these methods will not only increase agricultural productivity but also create additional income and employment generating opportunities to rural population.

(19) Post Harvest Technology

Appropriate post-harvest technology at the village level is a potent method of increasing the wealth of the village through the production of value-added products from agricultural raw material (Swaminathan, 1982). It involves cleaning, drying, storage and processing of produce available from agriculture, horticulture, floriculture, sericulture, etc. There are several devices available for post-harvest processing of produce. Unless production and post-harvest technologies are linked in the form of an integrated chain, the producer as well as the consumer will not be able to desire full benefits from the production effort.

(20) Potable Water Technology

Water borne diseases are quite common in rural areas. Potable water technology provides simple methods for making available safe drinking water, as well as, devices like deep-well hand-pumps, water-tanks etc. (CSIR, 1984).

(21) Poultry Development Technology

The contribution of the poultry industry to food production, particularly to high-quality protein, is unique. On the basis of technological support available, it is possible to start poultry at the village community level as additional income generating activity. The technology includes new system of housing and management, availability of superior germplasm to produce hybrid chicks; availability of nutritionally balanced compounded

feed; better health cover and indigenous production of poultry appliances; and research support from a nationwide network of veterinary and agricultural universities and research institutions (Masillamony, 1990).

(22) Rural Communication Technology

To improve communications in villages a rural wireless communication (RWC) system has been developed. This can be used for transmitting and receiving messages from villages to control station or vice-versa and to provide follow up action (CSIR, 1984).

(23) Rural Electrification Technology

Rural electrification has multiple functions in improving villagers' socio-economic life. In addition to laying transmission lines under rural electrification programme, several new and renewable source of energy (NRSE) are now made available for meeting rural energy requirements.

(24) Rural Road Technology

Roads are the life-line to prosperity of the rural community as they are not only the means for communication and transport, but also ensure easy and quick delivery of goods and marketing services of farm and dairy products. They generate more work opportunities for people staying in these areas. The rural road development technology include considerations such as, utilization and local raw materials (in road construction), nature of

vehicular traffic, especially the bullock-carts, local conditions of rainfall, nature of land, water-logging, etc. All these need an in-depth study of soil strata, survey and planning of the nature of construction material available locally and the technology of their conversion into materials appropriate for road construction. The soil stabilization techniques of construction recommended by Central Road Research Institute (CRRI) for rural roads is available for use (CSIR, 1984).

(25) Rural Sanitation Technology

This relates to the creation of clean and healthier environment in human settlements by tackling the negative effects of poor sanitation. This mainly consists of sanitary disposal of human excreta, garbage, animal dung, sullage, and dirty water (CSIR, 1984). The sanitation technology includes availability of the knowledge of not only rural latrines, soakage pits, waste water disposal system, etc., but also of the need for adopting hygienic practices which are not in conflict with the cultural mores, and which are within the economic means of the community (CSIR, 1984).

(26) Sericulture Development Technology

Sericulture is the process of production of silk through cultivation of mulberry and rearing of silk worms. Mulberry leaves, essential for silk-worm rearing, can be grown in wastelands and in shrub forest areas for silk-worm rearing (Balasubramanian, 1988). Mulberry is a deep rooting plant and it

withstands drought conditions. Sericulture has a short gestation period. Under tropical conditions, from the seventh month of raising a mulberry plantation, the farmers can start rearing silkworms and earn income. Silkworms can be reared every two to two-and-half months from the same plantation and yields can be had five to six time a year. During severe droughts, when all other crops wither, the farmer can still rear some quantity of silkworms from mulberry.

Low investment, more employment, and quick returns have made sericulture an ideal vocation for the weaker section of rural society. (ICAR, 1992).

(27) Smokeless Chulha (Wood Stove)

This is a newly designed wooden cooking stove that improves the fuel efficiency, reduces health hazards to women, and does not pollute the air in human settlement. It is a low-cost device and each rural household must possess it, mainly to reduce drudgery of women.

(28) Soil Management Technology

The soil management technology not only increases crop yields but also prevent deterioration of fertile agricultural land. This involves the use of appropriate tillage operation; regulation of soil moisture; maintenance of soil organic matter; choice and sequence of crops; providing adequate soil nutrients in

the form of fertilizers, and finally, periodical soil testing and land capability classification.

(29) Solar Energy Use Technology

This includes solar thermal and solar photovoltaic devices for varied applications in rural areas. Some of the solar thermal devices useful for the village cluster are: Solar cookers and solar driers. The solar photovoltaic devices are street lighting, water pumping, and domestic lighting unit (lantern) (Joshi, 1993).

In addition to solar thermal and solar photovoltaic appliances, effective utilisation of solar energy is possible through: (1) increased phytomass production from extensive energy plantation consisting of fast-growing trees, particularly leguminous shurbs and trees which can provide fuel, fodder, feed and fertilizer; (ii) cultivation of economically viable hydrocarbon yielding plants; and (iii) capturing as much solar energy as possible from cultivation of green plants in all empty patches of land (Swaminathan, 1982).

(30) Wasteland Reclamation Technology

This consists of installation of tubewells/pumpsets; bunding, leveling and drainage channels on the site; application of soil amendments like gypsum; and raising of suitable crop varieties. By sustained application of reclamation technology for two to three years, culturable wastelands may be made useful for agricultural purposes. The use of wasteland reclamation technology

may also include other simple agronomic techniques to reclaim soils (ICAR, 1992).

(31) Waste Recycling Technology

The organic waste available in the form of garbage and crop residues can be suitably used as a feed-stock for the production of bio-gas non-polluting fuel containing approximately 63% Methane, 27% Carbon dioxide and 10% Hydrogen, through anaerobic bacterial digestion. The residue is recovered as a nitrogen rich bio-manure. It, thus, serves three purposes in one process i.e. sanitation, fuel, and fertilizer (Sinha, 1990).

(32) Water Management Technology

Water management comprises irrigation or drainage or both depending on environmental conditions, soil, crops and climate. The technology used in water management ensures optimum utilization of both surface and ground water resources without causing environmental damage like water-logging, salt imbalance, etc. It includes practices related to irrigation and drainage. Irrigation practices comprise three fundamentals: when to irrigate, how much to irrigate, and how best to irrigate. Likewise, drainage comprises three fundamentals: how much to drain, how best to drain and how rapidly to drain under a given situation of soil, water and crops (ICAR, 1992).

6.2.2 Relevance of Identified Technologies

The identification of technologies as solution measures on the basis of disaggregation of salient variables in terms of their dimensionality implies formers' relevance in the intervention strategy. However, it will be useful if the relevance and utility of these technologies is further assessed keeping in mind the activity areas for sustainable rural development. This will be an additional policy input in the technological planning for sustainable development in the village cluster.

The five activity areas for sustainable rural development elaborated in Chapter 2, are:

1. Natural Resource Development;
2. Infrastructure Development;
3. Human Resource Development;
4. Agricultural Development; and
5. Rural Industries Development.

Each of these areas is now discussed and relevance of identified technologies in it, is explored.

1. Natural Resource Development

The sustainable utilization and maintenance of soil, water, forest and other primary assets is vital for lasting development. The basic natural resources to be managed and developed are water

and soil in conjunction with the plant and animal populations they support (often referred to as biomass). The system of vegetation associated with a particular soil-water-climate combination, represents the biomass of primary concern in natural resource management (Uphoff, 1987).

The water, soil and biomass* are renewable so long as they are managed together in a stable, mutually supportive system. The technologies relevant in natural resource management and development must ensure the renewable nature of these vital resources.

Table 6.2 shows technologies which meet the above criteria in the present context.

These technologies must be used in conjunction because most natural resource management even if focuses on just one resource such as biomass, must involve the other resources as well.

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* The biomass forms of special interest in rural development are trees, grasses, and crops. These biomass forms are renewable as long as water and suitable soils are available within tolerable climatic ranges (Uphoff, 1987).

Table 6.2

Technologies Useful in Natural Resource Development

Sl. No.	Technologies
i.	Afforestation Technology
ii.	Agroforestry
iii.	Bio gas Use Technology
iv.	Dryland Agriculture Technology
v.	Educational Technology
vi.	Floriculture Development Technology
vii.	Grassland Development Technology
viii.	Horticulture Development Technology
ix.	Integrated Nutrient Supply Technology
x.	Integrated Pest Control Technology
xi.	Integrated Weed Control Technology
xii.	Multiple and Mixed Cropping Technology
xiii.	Sericulture Development Technology
xiv.	Soil Management Technology
xv.	Solar Energy Use Technology
xvi.	Wasteland Reclamation Technology
xvii.	Waste Recycling Technology
xviii.	Water Management Technology

2. Infrastructure Development

The productivity, well-being, and security of rural people is greatly affected by the adequacy of the infrastructure that exists in their communities and that link them to district, provincial, and national centres of administration and commerce (Uphoff, 1987). Infrastructure includes transportation, power, communication, water supply (for domestic and irrigation purposes), and other facilities like, schools, clinics, post office, market place, community centre, sanitation facilities, etc.

The technologies relevant for infrastructure development in the present context are listed in Table 6.3. These technologies are of the nature that benefit the population directly and also provide services to agriculture and other rural enterprise.

Table 6.3

Technologies Useful in Infrastructure Development

Sl. No.	Technologies
i.	Educational Technology
ii.	Low-cost Housing Technology
iii.	Potable Water Technology
iv.	Rural Communication Technology
v.	Rural Electrification Technology
vi.	Rural Roads Technology
vii.	Rural Sanitation Technology
viii.	Rural Energy Use Technology
ix.	Waste Recycling Technology
x.	Water Management Technology

3. Human Resource Development

Human resource development is crucial for providing the energy and talent needed to transform economic and social conditions for the benefit of rural poor. As one of the activity areas for rural development, it is pursued in four programme areas: health, education, nutrition, and family welfare (Uphoff, 1987).

The technologies relevant for human resource development in the present context are listed in Table 6.4.

Table 6.4

Technologies Useful in Human Resource Development

Sl. No.	Technologies
i.	Basic Health Care Technology
ii.	Bio-gas Use Technology
iii.	Educational Technology
iv.	Family Welfare Technology
v.	Hazards and Accidents Protection Technology
vi.	Potable Water Technology
vii.	Rural Sanitation Technology
viii.	Smokeless Chulha

4. Agricultural Development

Technological improvements are vital for agricultural development activities which fall into three sets: (i) acquiring or preparing inputs; (ii) turning them into products through labour and management efforts; and (iii) putting output to best advantage (Uphoff, 1987).

The technologies relevant in agricultural development activities in the present context are listed in Table 6.5. Due to the complex nature of agriculture operations, it is difficult, if not impossible, to assess the relevance of identified technologies in inputs, production, and output activities of agriculture. Therefore, they have been listed under the single category viz., agricultural development.

Table 6.5

Technologies Useful in Agricultural Development

Sl. No.	Technologies
i.	Agroforestry
ii.	Bio-gas Use Technology
iii.	Biotechnology Technology
iv.	Dryland Agriculture Technology
v.	Educational Technology (Supportive)
vi.	Integrated Nutrient Supply Technology
vii.	Integrated Pest Control Technology
viii.	Integrated Weed Control Technology
ix.	Livestock Development Technology (Supportive)
x.	Multiple and Mixed Cropping Technology
xi.	Post Harvest Technology
xii.	Rural Communication Technology (Supportive)
xiii.	Rural Electrification Technology
xiv.	Rural Roads Technology (Supportive)
xv.	Soil Management Technology
xvi.	Solar Energy Use Technology
xvii.	Wasteland Reclamation Technology
xviii.	Waste Recycling Technology

5. Rural Industries Development

Rural industries development is an important activity area for rural development. Because of underemployment and seasonal unemployment, additional income earning opportunities have to be created for successful rural development. Rural industries development include such activities which create additional employment opportunities for poor villagers on the regular basis. Therefore, these activities are mostly related to agro-based production systems. The technologies relevant for rural industries development in the present context are listed in Table 6.6.

Table 6.6

Technologies Useful in Rural Industries Development

Sl. No.	Technologies
i.	Afforestation Technology
ii.	Agroforestry
iii.	Educational Technology (Supportive)
iv.	Floriculture Development Technology
v.	Grassland Development Technology
vi.	Horticulture Development Technology
vii.	Livestock Development Technology
viii.	Post Harvest Technology
ix.	Poultry Development Technology
x.	Rural Communication Technology (Supportive)
xi.	Rural Electrification Technology
xii.	Rural Roads Technology (Supportive)
xiii.	Sericulture Development Technology

The assessment of the relevance of identified technologies in five activity areas for sustainable rural development, reveals their strategic importance in the technological planning for the village cluster. In the next section, the mutually supportive or synergistic relationships among these technologies are worked out in terms of their role in achieving performance objectives of sustainable development in the village cluster.

6.3 Synergistic Technological Modules

The mutually supportive or synergistic relationships among relevant and useful technologies are explored here in terms of five performance objectives of sustainable rural development. The technological modules which represent sets of these mutually supportive technologies, constitute the axes and/or support bases for sustainable development in the given village cluster. All

these modules, put together, constitute the technological altus helpful in planning of change for sustainable transformation in the socio-ecological system of the village cluster.

The five performance objectives of sustainable rural development are:

1. Employment and Income Generation (EIG)
2. Productivity Improvement (PRI)
3. Basic Needs Satisfaction (BNS)
4. Synergistic Production (SYP)
5. Sustainability of Resource Use (SRU)

Since these performance objectives represent the goals of sustainable transformation in the socio-ecological system of the cluster, each identified technological solution must create the conditions for the achievement of at least one of these goals. Otherwise, the technological solution becomes superfluous in the planning of sustainable development strategy in the present context. The technologies which help in achieving one or more performance objectives may have mutually supportive or synergistic relationships among themselves by virtue of the fact that they are relevant to the same activity area of rural development. By way of illustration, it may be pointed out that if both Agroforestry and Livestock Development Technology are employment and income generating in nature, they are also mutually supportive because both are relevant to rural industries development in the cluster. However, the mutually supportive relationships may not exist among technologies despite their relevance to single activity area. The establishment of these relationships among technologies and

suggesting technological modules is a reiterative process and requires constant cross-checking with the experts of respective fields.

The synergistic relationships among technologies and corresponding technological modules (TM) with respect to each performance objective are delineated below:

6.3.1. Technological Module for Employment and Income Generation

The employment and income generation (EIG), as a performance objective of the system dynamics, indicates that technology-based intervention for sustainable rural development must create additional income earning opportunities if system malfunctioning is to be rectified. The technological support base for this purpose is found to be consisting of the following set of identified technologies:

1. Afforestation Technology (AFT)
2. Grassland Development Technology (GDT)
3. Agroforestry (AGF)
4. Wasteland Reclamation Technology (WRT)
5. Water Management Technology (WMT)
6. Rural Roads Technology (RRT)
7. Livestock Development Technology (LDT)
8. Sericulture Development Technology (SDT)
9. Horticulture Development Technology (HDT)
10. Floriculture Development Technology (FDT)
11. Poultry Development Technology (PDT)
12. Multiple and Mixed Cropping Technology (MMT)
13. Dryland Agriculture Technology (DAT)
14. Post Harvest Technology (PHT)

Empirical investigation in the village cluster reveals that except wasteland reclamation technology, the other technological inputs, listed above, are not available for use by interested

villagers in the cluster. The interviews with area-specific experts in government departments at the district level confirmed the suitability of these technologies in the village cluster and their crucial role in employment and income generation. When asked as to why majority of these technologies are not being disseminated for use among villagers, they lamented about the inadequate supply of inputs from central and state agencies, and more importantly, villagers' indifference towards technological innovation. On the contrary, majority of the participants in the group discussion on the need for technological solutions, felt that despite their willingness to improve their knowledge about new methods and skills, there is no agency whatsoever that could possibly provide them with the necessary inputs. Furthermore, villagers expressed their willingness to diversify their production base so that they could improve their income earning capability. Again, there was a feeling that village was not the place for venturing into new means of employment as it would not yield desired results in the absence of necessary support. Some of the elder participants in the group discussion emphasised that their age old methods of cropping and animal husbandry were better because they involved less risk and are easy to implement. However, two young educated participants who incidently belonged to dominant 'Thakur' caste and practiced agriculture, felt that crop diversification is economically very beneficial. They felt that marginal farmers would not be able to implement new methods because they lacked resources and the will to take risk.

In the back-drop of the above empirical revelations, the mutually reinforcing relationships among technologies suitable for employment and income generation, were worked out in consultation with a few enthusiastic experts in the district and some willing participants in the village. The forward linkages of each identified technology with other technologies were carefully determined keeping in mind their role in employment and income generation in the village cluster. For practical reasons, all the linkages are not elaborated here. However, in Table 6.7 the forward linkages of Afforestation Technology are explained with respect to their mutually supportive roles in employment and income generation opportunities.

Table 6.7

Afforestation Technology and its Synergistic Linkages

* Afforestation technology reinforces the implementation of Grassland Development Technology and Agroforestry in the form of silvi-pastoral and agri-silvi systems and thus, create more employment opportunities.

* Afforestation technology constitutes the important part of Wasteland Reclamation and Water Management Technologies which create more work opportunities in the form of wage labour and semi-skilled jobs.

* Afforestation technology is highly supportive of live-stock development because of potential for augmenting the availability of fodder and generation of forage.

* Afforestation technology directly supports the Sericulture and Horticulture Development Activities.

Table 6.8 shows synergistic relationships among all technologies found suitable for employment and income generation in the cluster.

Table 6.8

Synergistic Relationships among Technologies for Employment and Income Generation

Technologies	AFT	GDT	AGF	VRT	WMT	RRT	LDT	SDT	HDT	FDT	PDT	MMT	DAT	PHT	TOTAL LINKAGES
Afforestation		+	+	+	+		+	+	+						7
Grassland Development	+		+	+	+		+						+		6
Agroforestry	+	+		+	+		+	+	+			+	+		9
Wasteland Reclamation	+	+	+		+	+		+				+	+		8
Water Management	+	+	+	+				+	+	+		+	+		9
Rural Roads				+			+	+	+	+	+	+	+	+	9
Livestock Development	+	+	+			+						+	+	+	7
Sericulture Development	+		+	+	+	+							+	+	7
Horticulture Development	+		+		+	+							+	+	6
Floriculture Development					+	+							+	+	4
Poultry Development						+							+	+	3
Multiple & Mixed Cropping			++	++	+	+	+						+	+	7
Dryland Agriculture		+	++	+-	+	+	+	+	+	+	+	+		+	12
Post Harvest						+	+	+	+	+	+	+	+		8

Note: Plus (+) sign in this, as well as, in subsequent tables denotes a mutually supportive relationship between technologies. The total number of such signs indicate the linkages of a single technology.

From the above table, it may be deduced that Dryland Agriculture Technology has maximum forward linkages with other technologies. It therefore represents most important solution measure for employment and income generation in the village cluster. This is followed by Agroforestry, Water Management, Rural Roads Technologies, each of which have nine forward linkages. The technologies related to wasteland reclamation, and post harvest value-added production, are also quite important as they have eight linkages each with other technologies. This does not, however, mean that other technologies which have fewer linkages are not important. In fact, all the fourteen technologies shown in Table 6.8 as having linkages with other technologies constitute a technological module (TM) for employment and income generation in the village cluster.

6.3.2 Technological Module for Productivity Improvement

The goal of productivity improvement implies the use of measures that enhance the output per unit of input in all existing production activities in the village cluster. The objective of all productivity improvement efforts is to end the subsistence nature of production process which causes impoverishment among poor and marginal section of the village population. The marketable surplus created by improved productivity will provide a sustainable livelihood to the poor and impoverished sections.

The technological support base for this purpose is found to be consisting of the following set of identified technologies:

1. Soil Management Technology (SMT)
2. Water Management Technology (WMT)
3. Waste Recycling Technology (WRT)
4. Educational Technology (EDT) (Supportive)
5. Livestock Development Technology (LDT)
6. Horticulture Development Technology (HDT)
7. Biotechnology (BOT)
8. Multiple and Mixed Cropping Technology (MMT)
9. Dryland Agriculture Technology (DAT)
10. Integrated Nutrient Supply Technology (INT)
11. Integrated Weed Control Technology (IWT)
12. Integrated Pest Control Technology (IPT)
13. Bio-gas Use Technology (BGT)

The investigations in the village cluster reveal the absence of the widespread implementation of technologies listed above. Two bio-gas plants that have been set up, are non-functional and therefore do not provide manure for use in agriculture, and other related activities. When the potential of these technologies in productivity improvement was explained during the group discussion, the participants expressed their willingness to use some of them such as Livestock Development and Horticulture Development technologies. The preference for specific technologies appears to be due to participants' assessment of the potential returns from the application of most preferred technologies in the respective production activities. However, when the mutually supportive role of these technologies was emphasised in productivity improvement, doubts were expressed by the participants. The most common feeling was that existing development machinery would not be able to provide knowledge and skills required for the simultaneous implementation of all technologies in the village cluster. This indicates the urgent need for a single window delivery system for technology transfer.

Notwithstanding the felt organisational requirement for making the identified technologies available, mutually reinforcing nature of the same was worked out in consultation with a few area experts. Table 6.9 shows the synergistic linkages among technologies identified as relevant for productivity improvement.

Table 6.9

Synergistic Linkages Among Technologies for Productivity Improvement

chnologies	SMT	WMT	WRT	EDT	LDT	HDT	BOT	MMT	DAT	INT	IWT	IPT	BGT	TOTAL LINKAGES
il Management		+	+				+	+	+	+	+		+	8
ter Management	+							+	+	+	+			5
ste Recycling	+						+	+	+	+			+	6
ucational Technology Supportive)	+	+	+		+	+	+	+	+	+	+	+	+	12
vestock Development							+	+	+				+	4
rticulture Development							+		+			+	+	4
)technology	+		+		+	+		+	+	+	+	+		9
tiple & Mixed Cropping	+	+	+		+		+		+	+	+	+	+	10
rland Agriculture	+	+	+		+	+	+	+		+	+	+	+	11
egrated Nutrient Supply	+	+	+				+	+	+		+		+	8
egrated Weed Control	+	+					+	+	+	+				6
egrated Pest Control						+	+	+	+					4
-gas	+		+		+	+		+	+	+				7

It is apparent from the above table that Educational Technology has a dominant supportive role to play in the adoption and implementation of other productivity enhancing technologies. In terms of the mutual synergies, Dryland Agriculture Technology has the maximum linkages with other technologies which indicates its greater importance as solution measure for productivity improvement. The use of biotechnological inputs and multiple and mixed cropping techniques also emerge as important segments of the module. The Integrated Nutrient Supply and Soil Management technologies also appear to be important for productivity improvement. These technologies along with others shown in the table constitute the technological module (TM) for better productivity of presently carried out production activities like, agriculture, horticulture, and livestock raising.

6.3.3. Technological Module for Basic Needs Satisfaction

The non-satisfaction of the felt needs like, health care, education, child nutrition, fuel, fodder, potable water etc., leads to the poor quality of life in most households in the village cluster. The empirical evidence reveals the virtual absence of technological support for meeting these pressing needs of the cluster population. The only exception is the availability of safe drinking water that has been ensured through hand-pumps, but in only two hamlets of the cluster. Some other felt needs that are concerned with small and marginal peasants' degraded livelihood system such as, reclamation of wasteland (usar);

irrigation and other inputs etc., are also responsible for poor quality of life and impoverishment in the village cluster.

The technological module consisting of technologies identified for effectively meeting felt needs of the cluster population consists of the following:

1. Solar Energy Use Technology (SUT)
2. Afforestation Technology (AFT)
3. Grassland Development Technology (GDT)
4. Wasteland Reclamation Technology (WRT)
5. Water Management Technology (WMT)
6. Basic Health Care Technology (BHT)
7. Family Welfare Technology (FWT)
8. Hazards and Accidents Protection Technology (HPT)
9. Rural Sanitation Technology (RST)
10. Low-cost Housing Technology (LHT)
11. Potable Water Technology (PWT)
12. Livestock Development Technology (LTD)
13. Dryland Agriculture Technology (DAT)
14. Smokeless Chulha (SMC)
15. Educational Technology (EDT)
16. Bio-gas Use Technology (BGT)

These technologies address the most pressing needs of the cluster population. The participants in the group discussion on basic needs oriented technologies, expressed the consensus that above listed technologies must be made available to them. In fact, some of these technologies concerned with wasteland reclamation, potable water and smokeless Chulha are already being used by villagers and they seemed to have realized the benefits of some of these innovations.

Table 6.10 shows the synergistic linkages among technologies identified as suitable for meeting felt needs of the village population.

Table 6.10

Synergistic Linkages among Technologies for Basic Need Satisfaction

Technologies	SUT	AFT	GDT	WRT	WHT	BHT	FWT	HPT	RST	LHT	PWT	LDT	DAT	SMC	EDT	BGT	TOTAL LINKAGES
Solar Energy		+	+		+			+									4
Afforestation	+		+	+	+					+		+	+	+			8
Grassland Development	+	+		+	+					+		+	+				7
Wasteland Reclamation		+	+		+								+				4
Water Management	+	+	+	+									+				5
Basic Health Care							+	+	+		+						4
Family Welfare						+		+	+		+	+					5
Hazards & Accident Protection	+					+	+		+	+	+			+		+	8
Rural Sanitation						+	+	+		+	+			+		+	7
Low-Cost Housing		+	+					+	+								4
Potable Water						+	+	+	+								4
Livestock Development		+	+				+						+			+	5
Dryland Agriculture		+	+	+	+							+					5
Smokeless Chulha		+						+	+								3
Educational Technology	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	15
Bio-gas								+				+					2

The above table shows that Educational Technology has a very important role to play in imparting knowledge and skills about the adoption and implementation of all other technologies useful for basic needs safifaction in the village cluster. Afforestation Technology, and Hazards and Accidents Protection Technology emerge as having greater number of synergistic linkages. Thus, they form the important segment of the technological support base for basic need satisfaction. It may be noticed in the table that certain technologies which are related to basic health care, potable water, low-cost housing, smokeless Chulha, etc., have relatively less number of linkages. This however does not mean that they are less important in meeting basic needs of the cluster population. As a matter of fact, these technologies meet some of the most pressing felt needs. Since, the nature of felt basic needs is diverse, the supportive linkages among relevant technologies also come out to be less. Nonetheless, all these technologies constitute the support base for satisfaction of villagers' felt needs.

6.3.4 Technological Module for Synergistic Production

The synergistic production refers to the mutual advantages between two or more production activities. It leads to the production of value-added products, and at the same time maintains the sustainable operation of mutually reinforcing production activities. For example, the fruit crop production and fruit processing unit are two synergistic production activities each

sustaining the other. Similarly, packaging of fruit crops production can itself be very remunerative by increasing the marketability potential of the produce. The synergistic production is highly knowledge and skill intensive and requires consistent technological and training support.

The potential for synergistic production exists in the village cluster. The technologies needed for this purpose are the following:

1. Afforestation Technology (AFT)
2. Grassland Development Technology (GDT)
3. Agroforestry (AGF)
4. Livestock Development Technology (LDT)
5. Horticulture Development Technology (HDT)
6. Sericulture Development Technology (SDT)
7. Poultry Development Technology (PDT)
8. Floriculture Development Technology (FDT)
9. Multiple and Mixed Cropping Technology (MMT)
10. Dryland Agriculture Technology (DAT)
11. Post Harvest Technology (PHT)
12. Bio-gas Use Technology (BGT)
13. Educational Technology (EDT)

Some of the infrastructure creating technologies like, Rural Electrification, Roads, and Communication, which give impetus to synergistic production activities, are not included in the above list because they in any case required if diversification of production activities is to take place.

The group discussion on synergistic production technologies clearly revealed that participants were not keen on conjunctive adoption of such technologies, even if they are made available. Apparently, they did not want to face the risks involved in the multi-tier production system. However, when a clarification was given that all mutually supportive production activities need not

be carried out by members of a single household, they showed interest in the possibility of having such a production profile in the cluster. At the same time, there was a consensus that without credit, roads, transport, and electricity, technology supported synergistic production activities could not be sustained.

Notwithstanding villagers' skepticism, the mutually supportive relationships were worked out among technologies identified for initiating synergistic production in the village cluster. Table 6.11 shows the mutually supportive relationships among these technologies.

Table 6.11

Synergistic Linkages Among Technologies for Mutually Reinforcing Production Activities

Technologies	AFT	GDT	AGF	LDT	HDT	SDT	PDT	FDT	MMT	DAT	PHT	BGT	EDT	TOTAL LINKAGES
\fforestation		+	+	+	+	+			+	+				7
'rassland Development	+			+					+	+	+			5
groforestry	+			+	+	+			+	+	+			7
ivestock Development	+	+	+						+	+	+	+		7
)rticulture Development	+		+							+	+			4
:riculture Development	+		+							+	+			4
ultry Development										+	+			2
oriculture Development									+	+	+			3
ltiple & Mixed Cropping	+	+	+	+				+		+	+			7
'land Agriculture	+	+	+	+	+	+	+	+	+		+	+		11
t Harvest		+	+	+	+	+	+	+	+	+				9
-gas				+					+	+				3
cational Technology	+	+	+	+	+	+	+	+	+	+	+	+		12

It is apparent from the above table that Educational Technology and Dryland Agriculture Technology are more prominently linked with other production oriented technologies. It can be, therefore, deduced that for the development of synergistic production potential in the village, the availability of knowledge and skills related to relevant aspects of Dryland Agriculture Technology is absolutely necessary. The Post Harvest Technology Constitutes an important component of this technological module.

6.3.5 Technological Module for Sustainability of Resource Use

The bio-physical resources available in any socio-ecological system cannot be stretched indefinitely. Hence, the range of options for enhancing a system's performance are limited by key features of its resource base. In degraded resource areas like, in the present village cluster, the extensive and diversified use of resources will ensure sustainability. The regeneration of resources and their inter linked uses are the best options if sustainability is to be achieved at the operational level.

The technological support base for regeneration and inter-linked use of resources in the village cluster consists of same set of technologies which are earlier listed as relevant for natural resource development in the village cluster. Since, the concept of sustainable resource use implies the synergistic application of identified technologies, the mutual relationships among the latter are not worked out here. However, it may be emphasised here that technological application for sustainable

resource use does not aim at only conservation of natural ecosystem. Rather, the goal is to continuously maintain or enhance the flow of products and services in such a manner that their long-term potential is not damaged. In other words, the goal is to achieve 'intergenerational equity' in the use of resources in a given context.

6.3.6 Technology Atlas for Sustainable Rural Development

It is apparent from the above discussion of synergistic technological modules that technologies identified for various performance objectives are not mutually exclusive. A technology which is included in the TM for Employment and Income Generation may also be the constituent of TM for Productivity Improvement. Such a multi-applicability of the identified technologies may be further highlighted with reference to a technology altas for the rural system. The technology atlas so prepared may serve as a knowledge-base for a plan formulation team. This knowledge base can be modified as and when new socio-ecological conditions emerge in the given context.

A diagrammatic representation of the technology atlas concept may be outlined as in Figure 6.1

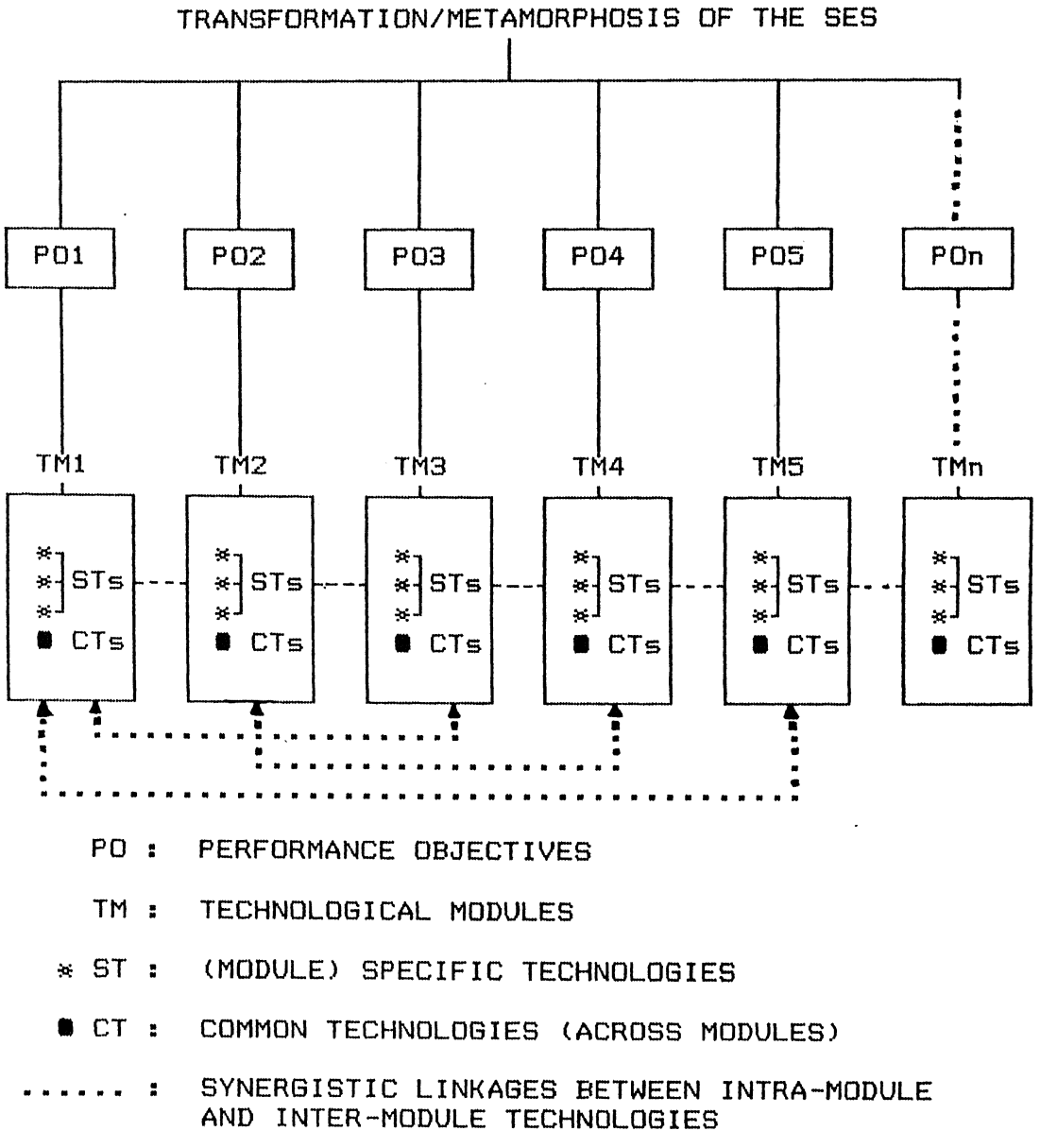

FIG.6.1. THE CONCEPT OF A TECHNOLOGY ATLAS FOR SOCIO- ECOLOGICAL SYSTEM TRANSFORMATION.

The concept of technology atlas as envisaged here represent a roadmap for transforming a given socio-ecological system toward a horizon of continuing sustained development. As such, it is meant to highlight the technological solution measures that are deemed to be required in a given specific context, as well as, the synergistic linkages among the identified technologies. The concept also provides for the incorporation of new and emerging changes in the relevant technologies in the light of future innovation.

6.4 Socio-cultural Issues in Transfer of Technological Modules

The transfer of technology to the intended users is one of the major management problems in all research and development organizations concerned with the generation and innovation of know-how and related techniques. The agricultural and rural development organizations concerned with technological research and development, are not an exception to this general trend. In most cases, the technology is available, but the mechanism for transferring it to the rural users in an effective manner does not exist (Swaminathan, 1982).

Among the factors responsible for poor performance of technology transfer mechanisms in impoverished rural areas, the "organizational underdevelopment" in village communities is considered as one of the most important one (Cernea, 1986). This acts as a major constraint to both optional decision making by individuals, and collective decision making within social systems

about choice of technologies and their adoption. As a result, the process of technology transfer fails to achieve its desired objectives in most rural communities of developing societies.

There are very few micro-level studies to explore the factors related to organisational underdevelopment and its consequences for technology selection, implementation, and management in rural communities. However, a few middle range generalizations have been suggested by researchers. For example, West (1983) analyses a set of five structural factors that have a bearing on diffusion and collective adoption of natural resource practices. These factors are related to (i) distributive equity; (ii) property rights; (iii) factionalism; (iv) community organizing; and (v) indigenous leadership. In the course of collective project introduction and implementation, all of these structural factors are subject to changes that may be threatening to vested interests in the community. The reaction of these vested interests in the community can in turn present an additional barrier to collective adoption of relevant technologies. Marglin (1990) refers to issues related to not only social structure but also those which are related to process of knowing and sharing knowledge in village communities. Appadurai (1990) argues that the disembeddedness of induced knowledge system from any social and religions grounding puts resistance to new technologies. The issues related to poor human capabilities which indicate the failure of technology transfer mechanisms are also mentioned in several studies. These are: unawareness of rural

lack of awareness

people regarding the possibilities of technological applications; lack of resources required for utilising the relevant technologies; and inability to organize for collective action and benefits on a permanent basis. The nature and dynamics of these generalised issues will vary in view of the divergent socio-cultural context of village communities.

In the context of the present study, the cluster-specific socio-cultural factors which may negatively influence the transfer of identified technological modules, are related to four elements of social subsystem, viz., social organization; knowledge and skills; consumption pattern; and production possibilities. These factors may be listed as below:

1. Caste-based socio-economic inequalities.
2. Inter-caste factionalism is rampant.
3. Politico-economic alignments between caste groups.
4. Intra-caste sociality and caste based indigenous leadership.
5. Local knowledge and skills are not integrated into government sponsored development programmes.
6. Unfulfilled felt needs and the resulting pessimism about the success of rural development schemes initiated by the government
7. Expansion of agriculture is perceived as costly and risk-prone.
8. Caste bias in other occupational preferences.
9. Urban-ward migration in search of employment.
10. Unwillingness to exploit new production possibilities available in the village.

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* This list of cluster-specific socio-cultural factors is not exhaustive. For detailed account of these factors please see chapter 3.

In addition to the above factors, the technology transfer process in the village cluster may be further constrained by the absence of a 'social technology' for building culturally compatible village level institutions, for organization development (OD) intervention in the existing organizations, and for designing new service delivery system/organisational apparatus. The identification of village-specific problem dimensions confirm the existence of these factors in the cluster. The corresponding organisational solutions represent a set of 'social technology' for implementing technology-intensive strategy of sustainable rural development in the village cluster. These organisational solution measures are:

1. Single-window delivery system for credit, technology transfer, and other services in the village.
2. Villagers' participation in programme formulation and implementation.
3. Improved programme management.
4. organization development (OD) intervention in existing cooperative societies in the village.
5. Formation of beneficiaries' associations.
6. Ensuring regular and efficient functioning of local-self government institutions (Panchyat).
7. Formation of village-level institutions for participatory management and use of common property resources in the village.
8. Strengthening the functioning of existing agri-business centre (Mandi Samiti) as a nodal centre of village economy.

These measures aim at rectifying the cluster-specific socio-cultural factors hindering the development process. With reference to technology transfer, however, the significance of organisational measure related to designing of delivery systems/organisational apparatus require major attention as no such single window facility exists at the village level. The participants in the groups discussions also expressed the urgent need for such a single window facility where they could get all the necessary information, inputs, and related service assistance for adoption, implementation and management of relevant technologies and their synergistic modules. The design of such a single window delivery system thus constitutes the major aspect of social planning for technology intensive approach to sustainable rural development in the present context.

6.5 Summary

This chapter has outlined the nature of identified technological measures, and has discussed their relevance to activity areas for sustainable rural development. The technological modules have been developed on the bases of mutually supportive linkages with respect to performance objectives of sustainable transformation process. The procedure involved in developing technological modules forces or precipitates learning from others - from other disciplines, from villagers, and from development functionaries - in a manner which is systematic and open. The concept of 'technology atlas' integrates all the modules in the form of a policy information system which maintains

flexibility and thus provides scope for its use in varied socio-ecological situations with suitable modifications, using the similar procedure. The task of transerring technological modules has also been discussed briefly with reference to the cluster-specific socio-cultural issues. This highlights the necessity of a culturally compatible implementation strategy, and an organisational apparatus/delivery system that counts on the people's ability to perceive the problems to be solved.

The design of envisaged delivery system is discussed in the next chapter.

CHAPTER 7

TOWARDS DESIGN OF A DELIVERY SYSTEM FOR TECHNOLOGY TRANSFER

7.1 Introduction

The preceding chapter elaborates the technological dimension of the required intervention strategy for sustainable development in the village cluster. In addition, a few cluster-specific socio-cultural issues are highlighted to underscore the necessity of a culturally compatible delivery system/organizational apparatus for transfer, adoption, and implementation of identified technological modules in the village cluster. The organizational/delivery system dimension of the technology-based strategy of sustainable rural development is discussed in the present chapter. The discussion here focuses on the structural thrust of development intervention. The attempt towards the design of a technology delivery system may also have wide applicability for varied contexts of rural development endeavours. The discussion here is oriented toward highlighting the key managerial and institutional aspects of intervention programmes for rural transformation.

The scheme of this chapter is as follows. Section 7.2 outlines the objectives, functions, structure, and processes of the delivery system in the context of the village cluster-specific requirements. The analysis also proposes a meta-level socio-cultural principle of system design for rural transformation which is elucidated in Section 7.3. The summary of the discussion is presented in Section 7.4.

7.2 Dimensions of Designing a Delivery System for the Villag Cluster

In organizational design several dimensions require attention. These can be grouped into four main aspects - objectives, functions, structure, and processes. These are inter-dependent, and require simultaneous attention. In fact, attention to one dimension would require matching attention to the other dimensions also. Any change in one dimension would necessarily produce some changes in, and will certainly have many implications and repercussions for, the other dimensions.

In the context of the required delivery system for the village cluster, these dimensions of designing are as following:

7.2.1 Objectives

The objectives of the proposed delivery system in the given context here, are definable in terms of the goal-state of the system.* The latter is formalised as the desired/planned viability states of the six salient variables of the problem's dynamic structure. The desired states of the salient variables may be recapitulated as follows:

(1) Formulation and execution of government's development schemes in such a manner that felt needs of the beneficiaries are met, and location-specific developmental requirements are effectively incorporated in the planning and implementation of schemes. (Salient Variable I)

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*Please see Chapter 5.

(2) Continuous and sustainable increase in the productivity o agriculture so that growing agricultural surplus is created and income base of the farming families expanded. (Salient Variable II)

(3) Continuing improvement in the quality of life of rural households in a manner such that their access to basic health care, education, potable water, domestic fuel, sanitation, and other infrastructural facilities are ensured, and upgraded in a regular manner. (Salient Variable III)

(4) Empowerment of impoverished and deprived sections so that their affordability of basic necessities of life is enhanced in a continuing manner, and the level of deprivation diminishes progressively. (Salient Variable IV)

(5) Continuing generation of wealth and resources through productivity and innovation so that the quantum of investible capital available to the rural households continues to grow. (Salient Variable V)

(6) The productivity of all the available resources to be amplified so that ecologically sustainable process of development proceeds along a spiralling path. (Salient Variable VI)

In terms of these desired states of salient variables, the objectives of the proposed delivery system may be classified into two categories, viz., General and Specific.

I. General Objectives:

The general objectives of the delivery system are two fold: one, to prevent the passage of any salient variable towards its critical limit; and two, to increase the values of all salient variables towards their planned levels.

These general objectives call for a regular monitoring and evaluation of the states of the salient variables to ensure effective management of development in the village cluster.

II. Specific Objectives:

The specific objectives define the short-term goals of the proposed delivery system. These are specified on the basis of the particular focus of each salient variable to be evaluated and monitored in the village cluster. Accordingly, there are six specific objectives as below:

(i) To ensure that local needs and aspirations are effectively incorporated in formulation and implementation of rural development schemes in the village cluster.

(ii) To ensure increases in agricultural productivity on a sustainable basis.

(iii) To ensure improvement in villagers' quality of life, and the development of infrastructure in the village cluster.

(iv) To promote organizational capacities of the impoverished and deprived sections, and to develop their individual capabilities.

(v) To ensure continuous generation of investible capital in the village cluster.

(vi) To popularize the productive and sustainable use of all the available resources in the village cluster.

These objectives need to be translated into specific tasks or functions which the envisaged delivery system must perform for

7.2.2 Functions

The delivery system is envisaged as a multi-focal service organization at the local level. The major thrust of its functions would be to provide multiple services related to technological inputs and innovation suitable for various activity areas of rural transformation to village entrepreneurs, as well as, to certain target groups of deprived sections in the cluster. Thus, the delivery system intends to be useful and functional for all the sections of village population. The specific functions or tasks of the delivery system, and related procedures may be as follows:-

(i) Appraisal

This involves the use of participatory techniques and procedures for sketching socio-ecological realities of the village, monitoring the dynamics of transformation processes, and evaluating the performance of development programmes.

(ii) Coordination

The delivery system will function as a coordinating agency between local, regional, state, and national levels. The task here would be to build rapport with social groups in the village, and establish collaborative horizontal linkages with village level public, voluntary, and private sector organizations. In addition, the vertical linkages with district, state, and national level planning, execution, and R & D organizations, besides donor agencies and NGOs, must also be established for effective information flow and necessary supplementary support.

(iii) Problem Identification and Solutions

This involves the use of participatory techniques for identifying cluster-specific problems and working out suitable technological solutions. This further requires creating a knowledge-base of relevant technologies; acquisition, adaptation, and demonstration of technologies; imparting training for the use of technologies; and more importantly, providing necessary inputs and services for adoption and sustained implementation of relevant technologies.

(iv) Organizing for Self-Help Activities

This involves promoting, facilitating, and assisting collaborative group action; providing relevant training to group members; and leadership development for group cohesion. This task is especially oriented towards collective action among the

impoverished and deprived sections of the village population.

(v) Support Base for Capital Generation

This involves supporting value-added production which leads to generation of wealth, and investible capital. The initial support will be in the form of adequate credit along with technological planning for the concerned production activities. The support for product development and marketing may also be provided to interested sections of the village population.

(vi) Social Advertising

This is the awareness and demand creating function of the delivery system for technological approach to productive and sustainable use of all bio-physical resources available in the village cluster. This involves the use of popular audio-visual media besides consultancy and persuasion.

The functions discussed above relate to the goals of the proposed delivery system. Other mandatory functions like, planning, budgeting, staffing, decision-making, etc., are not discussed as the focus here is on the proposed organization's role in successful implementation of technology-based strategy of sustainable rural development, and not on the internal organizational functioning. The latter is however, important from the point of view of effectiveness and efficiency of the proposed delivery system but, is beyond the scope of present discussion.

7.2.3 Structure

The structure of an organization refers to the division of the tasks or functions into different roles/segments, their inter-relationships, and the reporting network of work roles. It is the structure which sustains any changes to be made in the objectives, functions and processes. The structure would include both the formal structure of the organization into various divisions and sub-divisions, as well as, mechanisms like, teams, and task forces. The structure would also include the organic linkages amongst structural units.

The proposed delivery system as envisaged here is an area - specific, multi-functional, single window facility located in the village cluster itself. This unit may be structured into two domains of work. The first domain (D-1) may be concerned with the appraisal, coordination, and social advertising functions of the delivery system. The second domain (D-2), on the other hand, will be responsible for carrying out the remaining functions, i.e., Organizing for self help activities; supporting capital generation in the village; and problem identification and problem solution.

The proposed structure of the envisaged organizational apparatus may be illustrated as in figure 7.1.

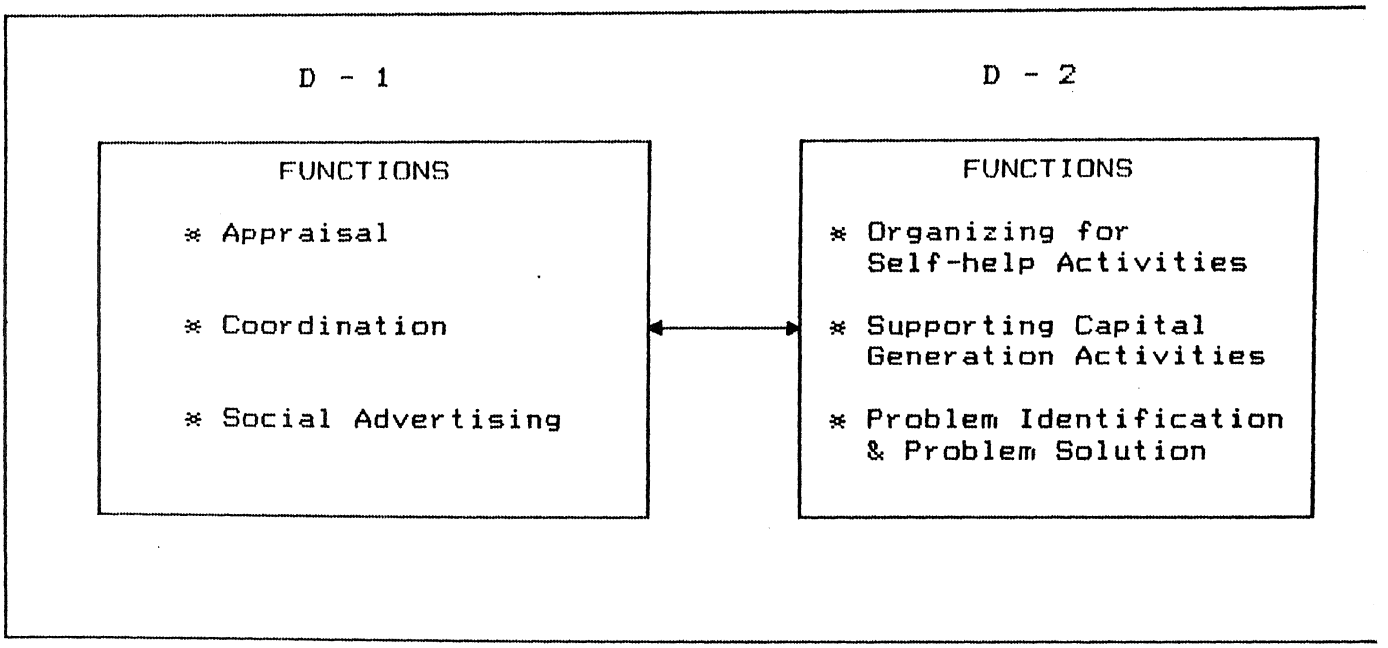


FIG.7.1 DOMAIN STRUCTURE OF THE ENVISAGED TECHNOLOGY DELIVERY SYSTEM FOR THE VILLAGE CLUSTER.

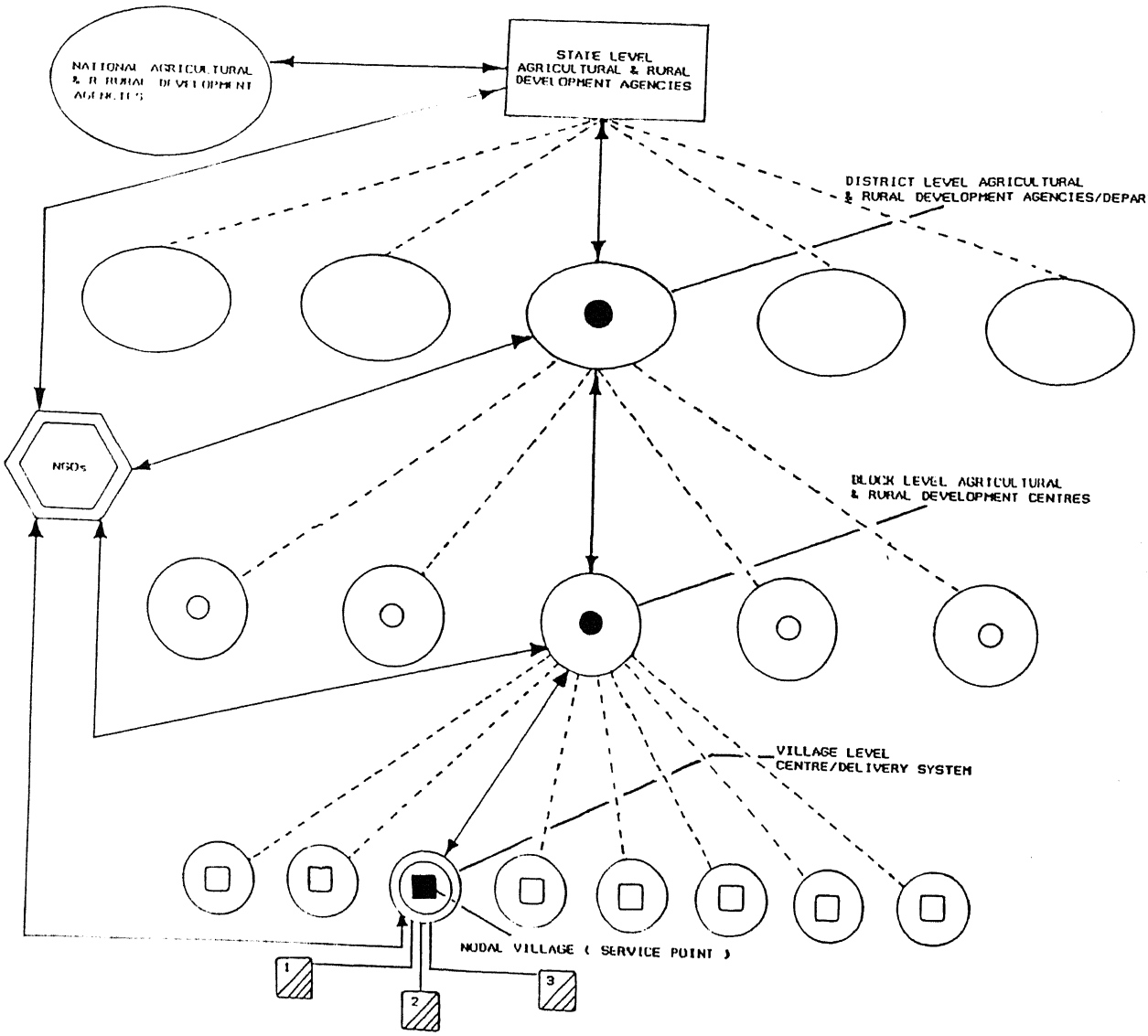
The two work domains are not rigidly structured compartments of the delivery system. Rather, they are envisaged to be highly flexible and interactive in order to respond to changes in the socio-ecological system of the village cluster. The inter-departmental relationship for coordinated task performance can be best achieved by informal face-to-face interactions keeping in view the total organizational goals. The strict managerial hierarchy will not be the most effective coordinative mechanism in the present context. A small apex level team may take the vital decisions in a timely manner. The organizational apparatus must ensure participation of intended beneficiaries in performance of requisite tasks on a regular basis. For this, the latter should have direct access to relevant personnel who would

incorporate their views into the performance of specific tasks. Thus, the effectively coordinated structure of the delivery system, may function in close collaboration with the collectivities of the village social organization, converting them to instrumental social groups with well defined degrees and types of local participation.

linkages of the domain structure of proposed village level delivery system, are illustrated in Figure 7.2.

The figure shows that the village level unit would be vertically linked to national, state, district, and block level agricultural and rural development agencies, departments, and centres. It should also be linked with the network of NGOs which maintain close working relationships with state, district, and block level centres. The horizontal linkages of the proposed unit would be with the village level public, voluntary, and private sector organizations.

In so far as, however, the availability of required manpower, as well as, expenditure involved may be a severe constraint in setting up a network of village units, an alternative would be to establish a full-fledged unit of resource persons with tele-communication facilitiesa at the block level. Such a structural unit may rotate itself among the specified set of village clusters on a regular and periodical basis. It would also act as a facilitating organization for village level



1 : VILLAGE LEVEL PUBLIC SECTOR ORGANISATIONS

2 : VILLAGE LEVEL VOLUNTARY SECTOR ORGANISATIONS

3 : VILLAGE LEVEL PRIVATE SECTOR ORGANISATIONS

FIG.7.2 STRUCTURAL LOCATION AND LINKAGES OF THE ENVISAGED DELIVERY SYSTEM FOR THE VILLAGE CLUSTER

institutional development, and human capacities enhancement. The latter should ensure ongoing local participation in the functioning of block-unit, by building a permanent structure of group action at the village level.

The structure of the proposed delivery system, at the village level, or at the block-level, will come into existence only when appropriate processes are designed and initiated by an external agency which may or may not be governmental.

7.2.4 Processes

Designing processes for the envisaged delivery system would involve enough attention to the ways of creating and sustaining an achievement oriented ethos of work and performance. In the present context, the latter would require a focus on technical factors; organizational culture and values; and processes of external and local interactions.

The technical factors pertain to 'technical inter-dependence' and 'technical uncertainly'*. There will be high degree of these two factors in a service oriented organization, such as the one envisaged here, because of the greater use of information and communication technology for efficient and personalized delivery

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* According to Cummings (1982), technical inter-dependence refers to the extent to which the technology requires cooperation among employees to produce a product or service. The technical uncertainly, on the other hand, indicates the amount of information processing and decision making, the employees must do in order to produce a product or service.

of inputs and services. This in turn, would call for small self-regulating work groups in which members have the multiple skills, discretion, and information necessary to control their interactions around the shared tasks.

The organizational culture and values constitute important elements of process dimension of designing organizations. In the present context, the organizational culture of the delivery system needs to be dominated by extension motivation, i.e., concern for the intended beneficiaries. Such a culture can be created by emphasizing elements of extension in training, work-design, and performance appraisal. The value of participation would be inculcated in organizational actors by emphasising learning-process in the planning and implementation of tasks and sub-tasks.

The processes of external interactions with national, state, district, and block level agencies/departments focus on innformation sharing for continued upgradation of services. The processes of local interactions with village level public, voluntary, and private organizations like, local rural development bureaucracy, panchayat, cooperatives, membership groups, business families etc., aim at the collaborative action for work performance. Both external and local interaction processes would require the use of information and communication technology for effectiveness of the linkages.

The dimensions of designing the delivery system as discussed above may be summarized as in Table 7.1.

Table 7.1

Dimensions of Designing Technology Delivery System

Objectives	Functions/Tasks	Structure	Processes
I. General Objectives (i) To prevent passage of salient variables to their critical limits (ii) To increase the values of all salient variables to their planned levels. II. Specific Objectives (i) To ensure incorporation of local needs and aspirations in development planing for the village. (ii) To ensure increase in agriculture productivity (iii) To ensure improvement in villagers' quality of life and development of infrastructure. (iv) To promote organizational and individual capacities of impoverished and deprived sections. (v) To ensure continuous generation of investible capital. (vi) To popularize the productive and sustainable use of all all available resources in the village.	(i) Appraisal (ii) Coordination (iii) Problem Identification and problem solution (iv) Organizing for self-activities (v) Supporting Capital generation activities (vi) Social Advertising	I. The Organization is structured into two work domains Domain - 1 (i) Appraisal (ii) Coordination (iii) Social Advertising Domain - 2 (i) Problem Identification and Problem Solutions (ii) Organizing for Self-help Activities. (iii) Supporting Capital Generation Activities. II. Timely decisions by a small team III. Beneficiary participation in tasks performance	I. Technical Factors in Work Design work groups II. Organizational Culture and Values (i) Extension Culture (ii) Values of participation and mutual learning (iii) Sustained training and skill development of work personnel (iv) Periodic appraisal of performance, internally and/or externally III. Interaction (i) With external rural development agencies (ii) With local groups and orgaanizations

It may be emphasized here that the envisaged design of the delivery system for technology - intensive approach to sustainable rural development, is an indicative one. A continuing assessment of its effectiveness and modification of its objectives, functions, structure, and processes as needed, is necessary from time to time.

7.3 A Meta-level Socio-cultural Principle of System Design.

In the context of the design of a delivery system for techno-structural transformation of the village socio-ecological system, an insight presented by Ruth Benedict (1970), the well know social anthropologist, is highly relevant. She advances a provocative concept of social synergy for the healthy functioning of socio-cultural systems. She writes:

> Societies where non-aggression is conspicuous, have social orders in which the individual, by the same act and at the same time, serves his own advantage and that of the group ..... Non-aggression occurs in these societies, not because people are unselfish and put social obligations above personal desires, but because social arrangements make these two identical..... Cultures with low social synergy are those in which the social structure provides for acts which are mutually opposed and counteractive, and cultures of high synergy where it provides for acts which are mutually reinforcing ..... In cultures with high social synergy, institutions ensure mutual advantage from their undertakings, while in societies with low social synergy, the advantage of one individual becomes a victory over another, and the majority who are not victorious must shift as they can.

In the similar vein, Maslow (1972) writes:

> The high synergy society is one in which virtue pays .... High synergy societies all have techniques for working off humiliation, and the low synergy societies uniformly do not.

It is evident that the concept of social synergy implies an over-arching ethos of harmony, cooperation, and shared goals and vision among members of a society. If such an ethos forms dominant part of a group's culture, the latter will be able to realize its developmental potential, and be able to unleash and harness the collective energy of its members.

In the context of the system design such a conceptual insight is exceedingly important, and may be deemed to provide a meta-level principle of system design. That is to say, the designed system in its entirety, i.e., in terms of its objectives, functions, structure, and processes, has to be suffused or undergirded by a principle of social synergy, i.e., harmony, cooperation, and shared vision and goals among the members of the village social system. This meta-level principle here implies that the personnel of the new organization, as well as, the intended beneficiaries, have to interact together in a social synergistic pattern of high level of harmony, cooperation, and shared goals.

The levels of delivery system design as visualized here may be shown diagrammatically as in Figure 7.3.

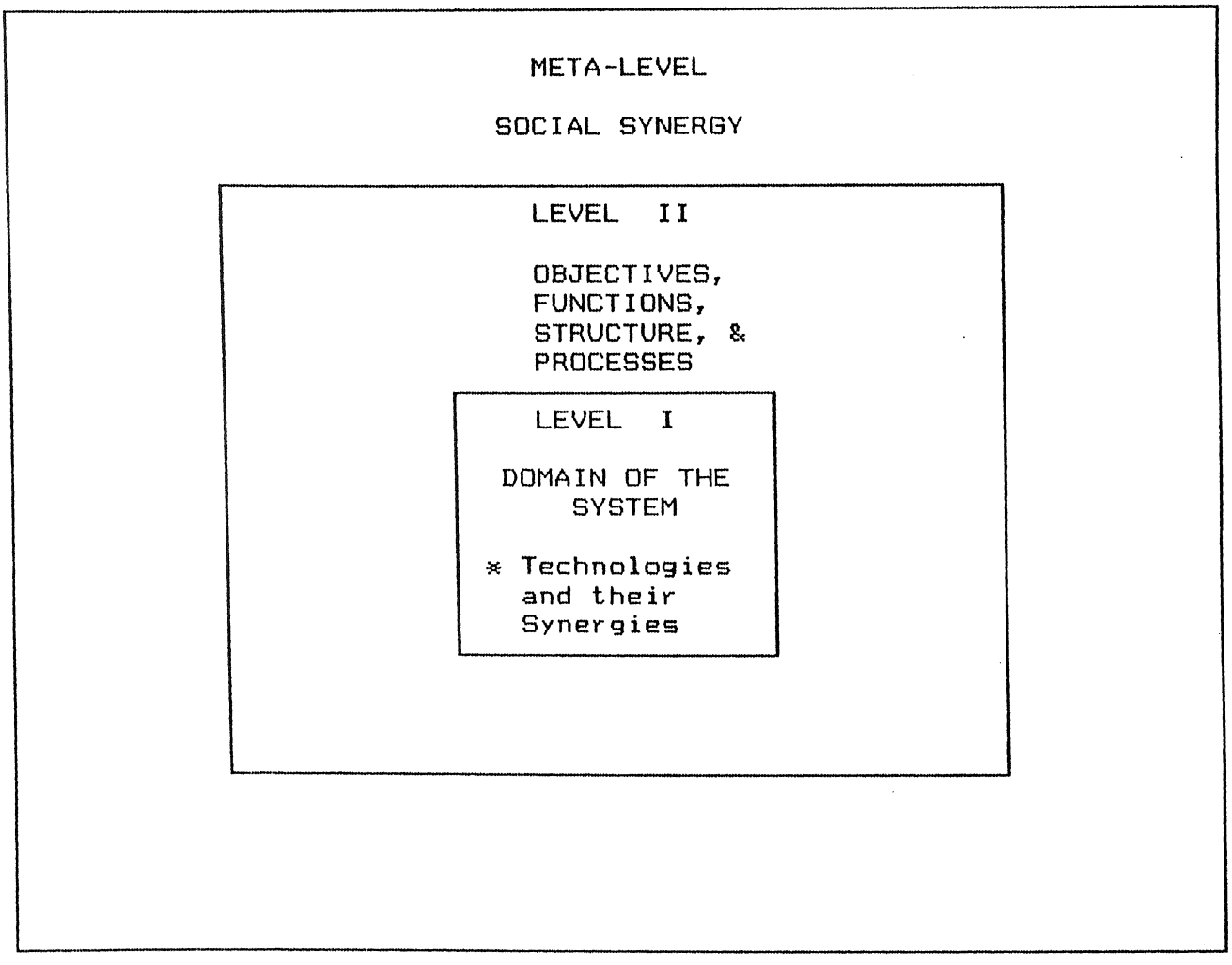

FIG.7.3 LEVELS OF DELIVERY SYSTEM DESIGN FOR TECHNOLOGY TRANSFER

It is apparent from the above figure that the first level of designing involves the identification of technological solutions for cluster-specific problems and determination of mutually supportive relationships among the same. This defines the domain of the delivery system. At the second level, the designing or redesigning exercise involves the delineation of objectives, functions, structure, and process dimensions in an integrated manner. Finally, the meta-level principle of social synergy provides the foundation for the socio-cultural compatibility and performance amplification of the design of the proposed delivery system.

It may be reiterated here that the actual techno-structural intervention for sustainable rural development may prove to be a very complex and tedious process. Without active support from an apex level developmental agency, the process may fail to achieve its desired goal state. Notwithstanding the real-life uncertainties, the conceptual and methodological framework attempted in this study shows that the planning of sustainable rural development at the micro-level of a village cluster is logically possible. The feasibility of such a framework can only be tested through an action-research project which would involve considerable collaboration between researchers and actual stakeholders.

7.4 Summary

This chapter has attempted a design of delivery system/organizational apparatus for technology-based strategy of sustainable rural development in terms of its objectives, functions, structure and processes. A meta-level socio-cultural principle of social synergy is seen to be crucial for the system's effectiveness.

CHAPTER 8

SUMMARY AND CONCLUSIONS

The basic premise of this study is that the control and reversal of impoverishment process in rural socio-ecological systems, requires the initiation of a systematic micro-level process of sustainable development. The latter requires such technological support-bases and/or axes which are location-specific and need-based. This further requires a culturally compatible organizational apparatus/delivery system for the management of transfer, adoption, and implementation of relevant technologies.

The study adopts the broad framework of policy research and elaborates the theoretical and methodological bases of the inquiry. By a systemic learning process approach, the study has attempted to evolve a technology-based intervention strategy for sustainable rural development in a village cluster of district Hardoi in Uttar Pradesh. This involves the appraisal of socio-economic, and ecological profiles of the cluster; analysis and understanding of the dynamics of socio-ecological impoverishment; identifying cluster-specific problem dimensions, and corresponding technological and organizational policy measures; outlining the nature and relevance of technological solution measures; working out synergistic technological modules; and suggesting a delivery system design for technology transfer.

In nutshell, the study seeks to build a conceptual and methodological framework for planned transformation of

impoverishment inducing factors by synergistic application of location-specific technological modules at the level of a village cluster. Its rationale emerges from the systemic learning process approach. The village cluster is viewed as a socio-ecological system (SES), which as a result of its complex dynamic functioning, gives rise to either impoverishment or development or both. The latter refer to systemic processes and are context dependent. In other words, the nature of impoverishment and/or development gets affected by complex interplay of local socio-ecological factors. The analysis and understanding of these processes of stagnation and transformation are essential if suitable technological means, and organizational modes are to be employed for the successful implementation of a strategy of sustainable development.

The particularized understanding of the nature and functioning of SES has been sought to be arrived at by the learning-process involving the use of participatory rural appraisal (PRA) methods for generating relevant data. Thus, the intended beneficiaries of planned change are involved in the process, besides area experts, peoples' representatives, development functionaries, and workers of a voluntary organization. The aim of learning process in the present context was to discern a clear pattern of change processes in the SES rather than to collect detailed quantitative and ethnographic details about socio-ecological factors.

The analysis of required policy measures, howeve emphasizes that conjunctive implementation of all of them is bas to the control of problem situation. The requirement conjuctive, timely, and effective implementation of all poli measures, necessitates the exploration of mutually supportive synergistic relationships among them. More specifically, thi calls for the identification of synergistic technological module and a comprehensive organizational design for successful adoption and implementation of identified modules.

The nature of all the technological measures is, therefore discussed in the light of secondary informations available in th literature. The relevance of these technological solutions i then explored in five activity areas for sustainable rura development by learning-process. This involves interviews wit the area experts, and organizing group discussions among villag participants. The mutually supportive or synergisti relationships among these technologies are also worked out in th similar manner. On the basis of these relationships, a set o five technological modules are deduced, each addressing t specific performance objective of sustainability in the villag cluster. The five technological modules (TMs) comprising relevan technologies are: (i) TM for Employment and Income Generation (ii) TM for Productivity Improvement; (iii) TM for Basic Nee Satisfaction; (iv) TM for Synergistic Productions; and (v) TM fo Sustainability of Resource Use. The five modules togethe constitute the technological dimension of sustainable rura

development in the given village cluster. In this context, a concept of 'technology atlas' is also envisaged that represents a context-specific technology roadmap for transforming a given socio-ecological system towards a horizon of sustained development. It is meant to highlight the technological solution measures that are deemed to be required in a given specific context, as well as, the synergistic linkages among the identified technologies. The concept also provides for the incorporation of new and emerging changes in the relevant technologies in the light of ongoing innovations. The cluster specific socio-cultural issues involved in the introduction and management of the technology-based intervention strategy are also identified in the study.

The organizational policy measures highlight the importance of a comprehensive planning for local institutional development in the village cluster. These measures are classified into three strategies of local institutional development, viz., organization development (OD) intervention; institution-building; and delivery system design. All three strategies need to be employed for rectification of cluster-specific socio-cultural factors hindering development process. However, in the specific context of technology transfer, the strategy concerned with delivery system design is found to be indispensable. In the absence of a single-window delivery system/organizational apparatus, for service management effectiveness, the success of the technology-based development intervention appears to be uncertain. Therefore, an

attempt is made to identify designing requirements for a single-window delivery system for the village cluster.

The specific objectives, functions, structure, and processes of the proposed delivery system emerge from the nature of cluster specific problem dimensions synoptically represented by salient variables of the problem. The proposed system would aim at achieving the goal state of problem solving by specific tasks or functions, flexible domain structure, and appropriate processes. A meta-level principle of system design is proposed that takes into account, nature of relevant technologies and their mutual synergies; objectives, functions, structure and process requirements for the system; and socio-cultural compatibility of techno-structural intervention for sustainable development.

To conclude, it may be stated that the study evolves, and establishes the significance of a conceptual and methodological approach that forms the basis for planning a technology-based strategy of sustainable rural development at the micro-level. Thus, a policy framework has been build up that highlights the technological dimension of sustainable rural development. This framework may be applied in varied contexts of rural development endeavours.

Recommendations for Further Work

The study is not free from its shortcomings. The most glaring limitation of the study is that the required techno-structural content of intervention strategy has not been actually

tested or applied in the real-world situation. In other words, the planning for development intervention in a given area, though based on a systemic learning process, ironically, remain a blue-print.

This limitation opens up the scope for further research in the area of policy studies on sustainable rural development. The action research projects of somewhat similar nature can be conceived where the initial research about the system provides information to guide subsequent action. Then, the results of the action are assessed to provide further information to guide further action, and so on. This iterative cycle of research and action would involve considerable collaboration between researchers, client-organizations, and policy-makers.

The action research projects can also contribute to knowledge generation about socio-ecological specificities of Indian rural society, and highlight the local assets and liabilities in the socio-sphere, as well as, in the eco-sphere. This knowledge will ultimately provide much needed inputs for public policy formulation and execution.

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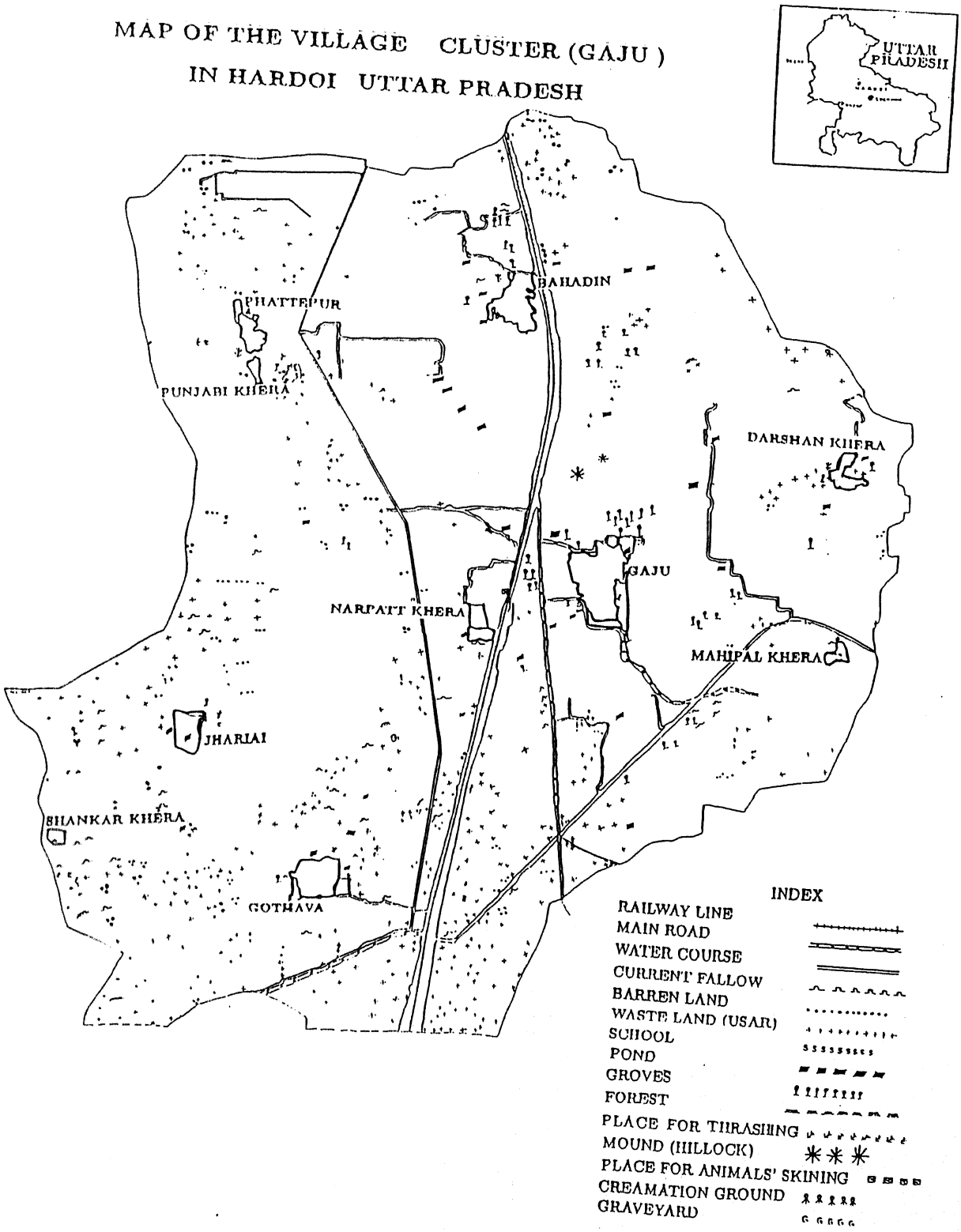
APPENDIX A


MAP OF THE VILLAGE CLUSTER (GAJU)
IN HARDOI UTTAR PRADESH
UTTAR PRADESH
SHI
BAHADIN
PHATTEPUR
PUNJABI KHERA
DARSHAN KHERA
GAJU
NARPATT KHERA
MAHIPAL KHERA
JHARIAI
SHANKAR KHERA
GOTHAVA
INDEX
RAILWAY LINE
MAIN ROAD
WATER COURSE
CURRENT FALLOW
BARREN LAND
WASTE LAND (USAR)
SCHOOL
POND
GROVES
FOREST
PLACE FOR THRASHING
MOUND (HILLOCK)
PLACE FOR ANIMALS' SKINING
CREAMATION GROUND
GRAVEYARD

APPENDIX B

Glossary of Local Words

Aam	Mango
Bargad	Banyan Tree
Chulha	Indegenous Stove
Gram Panchayat	Village Council
Gram Panchayat Adhikari	Village Council Officer
Gram Pradhan	Elected Leader of the Village Council
Gram Sabha	Cluster of Villages
Gram Vikas Adhikari	Village Development Officer
Jamun	Black-berry
Kathal	Jack-fruit
Khesari Dal	A local variety of pulse harmful for health
Mahua	Local tree fruit used for brewing liquor
Neem	A tree variety used as a natural pesticide
Peepal	A common tree variety
Sarkar	Government
Usar	Wasteland